“THIS IS WHAT I’VE SEEN”: CLIMATE CHANGE COMMUNICATION AND THE ARTICULATION OF LOCAL AND SCIENTIFIC KNOWLEDGE IN YOSEMITE NATIONAL PARK

by

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ABSTRACT

Climate change is predicted to have profound effects on ecosystems around the globe. Yet meaningful policy to address climate change has yet to be enacted, and American publics are perceived as disinterested and unconcerned about the issue. Public lands have the potential to act as valuable sites of climate change education and engagement to combat this lack of interest. Yosemite National Park, in California's Sierra Nevada Mountains, is one example of a public lands site that is already being affected by climate change, and where climate change communication efforts are underway. So far, climate change has caused significant warming, precipitation changes, and habitat loss in the park. As a high-profile, heavily visited national park that is already experiencing climate change impacts, Yosemite is a valuable case study of climate change communication in a public lands setting. This thesis explores articulations of climate change among Yosemite's visitors, employees, and texts produced by the park. Using a combination of rhetorical fieldwork and close reading, it examines the blending of local and scientific knowledge and the use of diverse environmental discourses in the construction of arguments about climate change, highlighting the potential of public lands as productive contexts for climate change engagement.

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INTRODUCTION

Climate change is predicted to have profound effects on the ecosystems in the United States that sustain and define the country's landscapes and communities, particularly in the West (Gonzalez, 2011; US EPA, 2016). According to Patrick Gonzalez (2011), the National Park Service's chief climate scientist, "Ninety-six percent of land administered by the National Park Service is located in areas of observed warming in the 20th century" (p. 10), which is attributable to anthropogenic greenhouse gas emissions. Effects of this warming include "glacial melt, decreased snowfall and snowpack, earlier spring warmth and streamflow, sea-level rise, increased conifer mortality, and shifts of vegetation biomes, small-mammal ranges, and winter bird ranges" (p. 10). Similarly, California's Sierra Nevada Mountains are expected to see a temperature rise of 4 to 8° F by the year 2100, which is likely to alter the region's snowpack dramatically (US EPA, 2016). This in turn will affect meadows, rivers, and streams, and usher in hotter, drier summers and increased wildland fire intensity and frequency. Land managers in Yosemite National Park, in the central Sierra Nevada, are bracing for these changes. Resource managers are planning for longer fire seasons and prolonged drought, while park educators and interpreters are seeking ways to engage visitors on the topic of climate change (Gonzalez, 2016; National Park Service, 2016).

Between 1960 and 2010, Yosemite saw an annual average temperature rise of 3.4 degrees Fahrenheit, which has already had significant impacts on the park's ecosystems,

including a shorter waterfall season, altered migration patterns of park wildlife, and species loss (Gonzalez, 2016). Whether Yosemite's millions of visitors perceive these already-present impacts, however, has yet to be explored. Approximately four million people visit Yosemite National Park annually, a number that has climbed steadily over the years (National Park Service, 2016), making Yosemite one of the most visited national parks in the country (National Park Service, 2014). As an iconic and heavily visited national park that stands to be greatly impacted by climate change, Yosemite is a useful site for the study of climate change communication in an already changing environment.

Public lands sites like Yosemite play an important role as contexts for climate change communication. Schweizer, Davis, and Thompson (2013) have found that "park and refuge visitors are seeking meaningful explanations and experiences to more deeply understand climate change impacts" (p. 43). For this reason, perceptions of and communication about the effects of climate change in Yosemite National Park bear examination as climate change communicators seek further avenues and settings for successful public engagement. To that end, the guiding questions of this thesis are: 1) How does climate change communication play out in public lands settings? 2) What is the role of public lands as productive contexts for climate change communication? Yosemite National Park, with its high levels of visitation and vulnerability to climate change, is a valuable case study that can begin to answer these questions. In order to understand how visitors, park employees, and Yosemite as an institution perceive and communicate about climate change, my thesis explores the ways in which multiple voices, including those of visitors, employees, and texts produced by the park, represent the relationship between climate change and Yosemite.

Using a combination of rhetorical fieldwork and close reading, I examine the ways in which visitors, employees, and park-produced texts articulate climate change as a perceptible, already-occurring force of change in the park. I argue that all three voices draw on both technical and nontechnical forms of evidence and argument about climate change. The effect is a depiction of climate change as a lived experience rather than a solely scientific phenomenon. These articulations challenge the distinctions between the technical, public, and private spheres of rhetoric (Goodnight, 1982). In doing so, they shed light on environmental rhetorics that use nonscientific arguments and strategies to persuade in ways that offer valuable alternatives to strictly scientific knowledge and discourses. In particular, these articulations of climate change as an already-felt force of change suggest that narrative, local knowledge, and nonscientific rhetorics are important elements of climate change communication in a national park setting. Furthermore, the voices examined in this thesis illustrate the significance of blended rhetorics, which employ multiple forms of knowledge at once, to illuminate the complexities of climate change as both a scientific and experienced phenomenon with already-felt effects. Together, these diverse articulations of climate change demonstrate that climate change communication comes from many sources, is informed by both scientific and local knowledge, and is the site of interaction between multiple environmental rhetorics and ways of knowing.

This thesis also entails a significant practical component. Not only do I explore the theoretical implications of blended forms of knowledge in the articulation of climate change, I am also interested in examining the ways in which public lands can foster climate change engagement more productively. Cox (2007) has argued that, because of the role it can play in addressing impending widespread ecological collapse,

environmental communication is a crisis discipline with an ethical duty to provide tools for practitioners. In this vein, one goal of this thesis is to contribute, in some small way, to the amelioration of the climate crisis by providing practical recommendations for climate change communicators in Yosemite to enhance their climate change engagement efforts. To do this, I look at the ways that visitors already connect their experiences in a national park with their perceptions of climate change, and assess the ways in which the National Park Service meets and falls short of its potential as an advocate for sustainable action to mitigate climate change. This contributes to the literature on climate change communication because it draws attention to the ways in which publics perceive climate change as locally and currently relevant in public lands and in their home environments, and not only as a distant, future threat. This in turn might serve as a foundation for more robust personal and collective action to curb runaway greenhouse gas emissions and prevent increased climate change.

In the following sections, I provide an overview of the literature on climate change communication, public understanding of science, and local versus technical knowledge, all of which inform this project. I then describe the methods I used to gather and analyze the articulations of climate change explored in this thesis. Finally, I provide an overview of the chapters that follow.

Conveying Climate Change on the Ground: Entering a Scholarly Conversation

Heuristic Framework

Drawing on the literature on climate change communication, public understanding of science (PUS), and local knowledge, I weave together a heuristic framework to explore

the ways in which local and scientific knowledge interact in the articulation of climate change perceptions in Yosemite National Park. This framework brings critical attention to the ways in which members of publics see (or fail to see) and describe (or deny) the effects of climate change that are already apparent on the local level, drawing on both local and scientific knowledge to do so. It also sheds light on the ways in which public institutions like the National Park Service use both scientific and nonscientific, experiential discourses to discuss climate change. By nonscientific discourses, I mean those that stray from the purely rational, disinterested, and neutral discourse traditionally used by scientists (Halloran, 1984; Prelli, 1997). These nonscientific, experiential discourses represent important opportunities to expand the persuasive potential of climate change communication to include that which centers on the lived, felt experience of climate change as it plays out in daily life. Exploring the relationship between traditional scientific and nonscientific discourses brings critical attention to areas of overlap and disjunct between the rhetorics of technical experts and nonexperts and challenges the supremacy of the purely scientific. It also sheds light on the role of public lands settings as contexts for scientific and nonscientific discourses in conversation with one another.

The heuristic framework I have described guides each chapter of this thesis. While it provides a broad lens on the place-based rhetorical practices of publics and institutions as they articulate the science and experience of climate change, each chapter grapples with its own unique and specific questions. For this reason, each one draws on a different theoretical framework. I engage each of these theoretical frameworks in the chapters that follow, providing an in-depth literature review in every one. Below, I offer an overview of the literatures that inform my broader heuristic framework.

Literature Review

Climate change communication

Despite the serious threat it poses to human and other communities, climate change remains "the first major environmental crisis in which experts appear more alarmed than the public" (Hamblyn, 2009, p. 234), at least in the United States. Climate change communicators have employed a variety of engagement strategies aimed at counteracting this apathy to prompt public concern and action. Climate change communication is therefore a broad area of study that explores many perspectives and approaches and encompasses the ways in which publics, experts, and institutions communicate about climate change (Moser & Dilling, 2007). This thesis, then, fits squarely within the scope of climate change communication, as it explores how members of publics and Yosemite as an organization perceive and articulate diverse understandings of climate change.

Some forms of climate change communication are more effective than others. Quantitative research on the outcomes of climate change messages has found that "the use of fear-inducing or dramatic representations of climate change can be counterproductive when public engagement is a concern" (O'Neill & Nicholson-Cole, 2009, p. 375). Alternative, more effective methods of public engagement have included moral and emotional appeals (Roeser, 2012), visual representations of the likely effects of climate change (Schroth, Angel, Sheppard, & Dulic, 2014), and emphasis on local effects (Moser, 2007; Schroth et al., 2014; Schweizer et al., 2013). These varying rhetorical approaches, from fear appeals to the highly technical language that characterizes documents like the official assessment reports from the Intergovernmental Panel on Climate Change, demonstrate the breadth of environmental discourses that can be mobilized in climate change communication.

One of the dominant discourses of climate change communication is the rational scientific (which I explore in depth in Chapter III) because climate change has long been perceived primarily as the domain of scientific experts (Leiserowitz, Marlon, & Smith, 2010). Among scientific communities, anthropogenic climate change has been accepted widely as a verifiable phenomenon with already observable impacts (Banning, 2009; Ceccarelli, 2011; Gonzalez, 2011; Hamblyn, 2009; IPCC, 2014). However, as a phenomenon whose effects are predicted to continue and intensify long into the future, there is a significant degree of uncertainty regarding the precise outcomes of climate change, primarily because future event modeling is complex and challenging (Walsh, 2010). For this reason, many predictive models of climate change feature a range of possible scenarios, including slight to severe warming trends, which would depend largely on how quickly and dramatically carbon dioxide emissions could be cut (IPCC, 2014; Walsh, 2010). This uncertainty regarding the precise, ultimate consequences of climate change has resulted in a "manufactured controversy," as those with an interest in preserving the status quo underscore scientific uncertainty as a means of portraying climate change as an issue that has yet to be settled (Banning, 2009; Ceccarelli, 2011). This results in confusion for lay publics (Hamblyn, 2009), who remain unconvinced that climate change is real or the result of human actions, and diminished support for policies and personal behavior changes that would mitigate climate change.

This manufactured controversy has also politicized the issue of climate change and moved it into the public sphere as a topic of public debate (Banning, 2009). It was further politicized under the Bush Administration, which forbade government agencies from discussing climate change as a scientific certainty, despite early consensus in the scientific community regarding the threat (United States House of Representatives

Committee on Oversight and Government Reform, 2007). This policy was reversed under the Obama administration, and in 2010, Jonathan Jarvis, then director of the National Park Service, declared that climate change is "fundamentally the greatest threat to the integrity of our national parks that we have ever experienced. The current science confirms the planet is warming and the effects are here and now*"* (National Park Service, 2010). As of this writing, it remains unclear how the Trump administration will instruct National Park Service employees to handle the subject of climate change with national park visitors.

Despite its politicization and public controversy, anthropogenic climate change is uncontroversial in the scientific community (Fischhoff, 2007). The uncertainty lies not in whether climate change is occurring and is human caused, but in the precise, ultimate effects of climate change, which can only be predicted, not known with total certainty (Walsh, 2010). Yet climate scientists are also studying the ecological effects climate change has had already, rather than focusing solely on predictive models of future events (Gonzalez, 2011). Little research has been done, however, on communication related to currently seen climate change effects. The currently and locally relevant nature of climate change could be an important platform for increased public engagement around the issue. This thesis begins to address this gap in the literature by exploring the ways in which diverse voices in Yosemite National Park portray climate change as a current (rather than strictly future) event, drawing attention to the role of a national park setting in prompting climate change awareness and engagement.

Despite the already observable effects of climate change, scholars of climate change communication have tended to emphasize that lay publics usually do not see climate change as a locally or personally relevant problem, and that climate change engagement

is more effective when it focuses on the (largely future) effects of climate change rather than the scientific mechanisms behind the phenomenon (Leiserowitz, 2005; Leiserowitz et al., 2014; Lorenzoni, Nicholson-Cole, & Whitmarsh, 2007; Uzzell, 2000; Whitmarsh, O'Neill, & Lorenzoni, 2015). Much extant research focuses on approaches that localize and concretize the future effects of climate change in order to prompt a sense of personal responsibility (Hamblyn 2009; Schroth et al., 2014; Schweizer et al., 2013). These studies are based on the assumption that lay publics do not already see climate change effects in their home environments. This thesis challenges this assumption by exploring the ways in which members of publics do indeed perceive climate change to be locally relevant and currently perceptible in a national park, and expands existing research by examining how members of publics articulate already visible environmental changes.

Public understanding of science. Focusing on the ways in which climate change is experienced as a lived phenomenon is an important move away from a strict deficit model approach to climate change engagement, which has tended to dominate science and climate change communication efforts (Brossard & Lewenstein, 2009; Gross, 1994). The "deficit" in the deficit model refers to the dearth of scientific knowledge on the part of lay publics, which science communicators try to remedy through the dissemination of scientific facts about relevant scientific processes like the carbon cycle (Brossard & Lewenstein, 2009; MacMillan, 2016; Woods Hole Research Center, 2016). Scholars of public understanding of science have examined the deficit model and its consequences for science communication efforts (Brossard & Lewenstein, 2009; Condit, Lynch, & Winderman, 2012; Endres, 2009; Gross, 1994; Miller, 2001; Secko, Amend, & Friday, 2013). Surveys of public scientific literacy have consistently found, over the course of the past 30 years, that fewer than 10% of Americans are scientifically literate, while

subsequent surveys of scientific literacy perpetuate the use of the deficit model "by consistently documenting public ignorance of science" (Gross, 1994, p. 6). Miller (2001) noted that these efforts have most often "adopted a one-way, top-down communication process, in which scientists—with all the required information—filled the knowledge vacuum in the scientifically illiterate general public as they saw fit" (p. 116). These efforts fail to recognize that members of publics have existing local knowledge and, often, a degree of scientific competency (Kinsella, 2004).

There are a number of other problems with the deficit model. First, it is ineffective; low rates of scientific literacy have remained remarkably stable over the decades (Brossard & Lewenstein, 2009). Furthermore, use of the deficit model perpetuates what rhetorical scholars consider "the false view that the problems all have to do with the public's understandings rather than also with scientists and scientific institutions" (Wynne, 1991, p. 12). It also consolidates the unequal "power relationships between those with the particular knowledge measured by the surveys and those without" (Brossard & Lewenstein, 2009, p. 13). This thesis challenges these power relationships by exploring how nonscientists make scientific arguments by drawing on technical and other forms of knowledge.

In response to the shortcomings of the deficit model, a number of scholars have proposed alternative ways of studying PUS that value local knowledge and experience (Endres, 2009; Fischer, 2000; Gross, 1994; Kinsella, 2004). The study of local forms of knowledge recognizes that "in the real world, [scientific understanding] is always integrated with supplementary assumptions that render it culture-bound and parochial…Efforts to communicate that ignore this fuller social dimension are likely to be ineffectual or even counterproductive" (Wynne, 1989, p. 12). According to Brossard

and Lewenstein (2009), "There has been little attention to other forms of knowledge that may be relevant to individuals in their real, everyday lives" (p. 13). In other words, science communication that is devoid of reference to lived experience is likely to be ineffective.

Although PUS has traditionally focused on "models and strategies that decision makers and scientists can use to teach or involve publics in science and science policy" (Endres, 2009, p. 52), Delicath (2004) advocated that PUS should broaden its focus to include "the skills, knowledges, and emotions involved in citizen advocacy outside of specific forums of government" (p. 255). Kinsella (2004) has called for greater attention to public expertise, which he defines as "technical competency acquired and used directly by affected citizens" (p. 85), as well as local knowledge based on lived experience. This thesis begins to answer this call by exploring the relationship between the scientific knowledge of lay publics and their experiential knowledge of the local environment and the ways in which a national park setting facilitates connections between the two.

Local knowledge. Local knowledge is an important, but often overlooked, form of public expertise and source of information about changing environmental conditions on the local level, particularly in regard to climate change effects (Cruikshank, 2010; Raymond et al., 2010). Fischer (2000) has defined local knowledge as

> knowledge about a local context or setting, including empirical knowledge of specific characteristics, circumstances, events, and relationships, as well as the normative understandings of their meaning. As such, it is a type of knowledge that owes its status not to distinctive professional methods but to casual empiricism, thoughtful reflection, and common sense. (p. 146)

I extend the literature on local knowledge by exploring its role in producing perceptions and accounts of lived experiences of climate change in a public lands setting.

Local knowledge is often contrasted with technical knowledge, which is proficiency

with scientific terms, concepts, and reasoning (Kinsella, 2004). This form of scientific knowledge is assumed to be "objective, verifiable, and tested using accepted methods" (Taylor & de Loë, 2010, p. 1208). Local knowledge, by contrast, is "context bound, community specific, and nonsystematic because it is generated ground up through social practice in everyday life" (Canagarajah, 2002, p. 244). Local knowledge, then, is rooted in lived experience and the collectively generated meanings assigned to those experiences.

However, Taylor and de Loë (2010) have complicated the distinction between local and technical knowledge by exploring the ways the two types of knowledge overlap, noting that

> local knowledge can also be held by scientists and technicians working in local offices… Thus, individuals can hold both 'local' and 'scientific' knowledge, and in some cases may find it difficult to untangle the two. (p. 1209)

As I discuss in Chapter II, Yosemite's interpreters exemplify this overlap through their use of arguments that blend technical and local knowledge. This blending is an important example of "real-world" public climate change communication, which can couple articulations of scientific processes with anecdotes of climate change experience to convey the complexities of a phenomenon that is both abstract and felt.

Sense of place is an important foundation for local knowledge and facilitates the environmental awareness necessary to develop local knowledge. Bricker and Kerstetter (2010) have defined sense of place as "individuals' relationship with their surroundings" (p. 233). Rose (1995) emphasized that one's sense of place is personal, emotional, and tied to identity. According to Stedman (2003), "Sense of place is based on symbolic meanings attributed to the setting" (p. 672) and is inseparable from the physical attributes of the place. While sense of place has often been associated with ideas of home (Rose,

1995), it can also be developed in national park sites where people visit rather than dwell. Tuan (2001) has noted that sense of place often develops over time but can also happen in the form of an instant connection to or sense of belonging in a place. Applied to national park sites, a visitor who returns year after year might develop a strong sense of place there over time, while a first-time visitor might develop an immediate affective connection to the landscape. Employees, who live in national parks or the outlying areas, can develop a sense of home in the park where they work, which is its own form of sense of place. The role of sense of place in national parks and other public lands is an important area of study (Schweizer et al., 2013). This thesis contributes to the literature on sense of place in national parks by exploring the ways in which both visitors and employees use sense of place to understand and talk about climate change.

In order to tap into the insights provided by local knowledge of climate change effects, it is important to attend to the ways local actors articulate their senses of place as they relate to environmental changes. I attempt to do so by examining the ways in which publics and Yosemite as an institution convey diverse impressions of and arguments about climate change, exploring varying relationships to the scientific and experiential components of climate change as it plays out on the local level. This sheds light on the already-felt nature of climate change effects and the ways members of publics and institutions draw on elements of experience in the local environment to illustrate climate change as currently and locally felt.

Method

To better understand how articulations of climate change occur in and are shaped by a national park setting, I conducted semistructured, in-depth interviews with visitors and

employees in Yosemite National Park, and collected and analyzed texts produced by the park, including written text and videos on Yosemite's website, interpretive and educational signs and exhibits located in the park, and all the editions of the park's informational newspaper published in 2016. To do this, I collaborated with the National Park Service to conduct my fieldwork in the summer of 2016.[1] I was in my ninth season of employment with the National Park Service in Yosemite during this period, which facilitated access to visitors, employees, and educational and interpretive texts. In each chapter, I provide an in-depth explanation of the methods used to gather the data analyzed in that chapter. For the purposes of this introduction, I explain my broader methodological approach.

I used rhetorical fieldwork to access the various voices in Yosemite that articulate diverse perceptions of climate change. Endres, Hess, Senda-Cook, and Middleton (2016) have defined rhetorical fieldwork as "a set of approaches that integrate rhetorical and qualitative inquiry toward the examination of *in situ* practices and performances in a rhetorical field" (p. 511). Rhetorical fieldwork, which uses qualitative approaches such as interviewing and ethnography, facilitates the study of "extratextual forms of *in situ* rhetoric" (Middleton, Hess, Endres, & Senda-Cook, 2015, p. xiv). By conducting interviews, I was able to access nonwritten articulations of climate change by Yosemite's visitors and interpreters. This deviates from traditional rhetorical criticism, which focuses on already documented texts (Endres et al., 2016; Middleton et al., 2015; Senda-Cook, 2012). Rhetorical fieldwork opens up for analysis a broader swath of climate change communication in Yosemite that would have been unavailable to traditional rhetorical

[1] Before beginning my fieldwork, I obtained a research permit from the National Park Service and approval from the Institutional Review Board at the University of Utah.

criticism.

Rhetorical fieldwork pays attention to the role of the researcher's body in shaping and participating in the rhetorical practices she or he studies (Middleton et al., 2015). Alasuutari (1995) pointed out that qualitative approaches like those adopted in rhetorical fieldwork recognize that the researcher cannot access and record an "objective" reality that occurs "in the world 'out there'" (p. 48), but rather that the questions asked play a role in the answers participants give, and the mere fact of the researcher's presence alters the practices she observes.[2] For this reason, it is important to acknowledge my role in prompting awareness of and discussions about climate change, especially among visitors who might not otherwise have been attuned to local climate change effects in Yosemite. Additionally, my status as an insider among the employees who participated in interviews may have influenced their responses, although it likely also created a shared context and greater mutual understanding. Keeping field notes was an important practice that facilitated reflexivity regarding my own role as both a shaper and researcher of climate change rhetoric in Yosemite (Emerson, Fretz, & Shaw, 1995).

After conducting these visitor and employee interviews and collecting park-produced texts, I transcribed them all for close reading. I used an inductive approach in which I read transcripts "repeatedly, closely, and carefully" in order to find "rhetorical commonalities" between the rhetorical texts and practices of participants (Benoit, 2016, p. 53). This analysis led to the development of my heuristic framework by revealing repeated use of both scientific and local knowledge to make arguments about climate change. I therefore turned to the three literatures described above as lenses for

[2] Although Alasuutari did not address rhetorical field methods specifically, his arguments about the nature of qualitative research apply.

understanding the complex interplay between technical and local knowledge in articulations of and arguments about climate change.

Organization of the Thesis

In the chapters that follow, I expand on the relationship between diverse forms of knowledge and their role in articulations of climate change. In Chapter I, I explore the role of climate change icons in the verbal illustration of local climate change. Specifically, I argue that 1) visitors already perceive climate change in Yosemite and articulate these perceptions using climate change icons from the local environment; 2) the kinds of icons visitors generate are influenced by the visitor's degree of sense of place in Yosemite and/or a home environment; and 3) icons serve as evidence in verbal-visual arguments about the nature of climate change. I close the chapter with a discussion of the practical implications of national parks as sources of climate change icons and engagement.

In Chapter II, I examine the blended rhetoric of Yosemite's employees, who use personal narratives of lived climate change experience as evidence in scientific arguments. I explore how the combining of technical and local knowledge challenges the distinction between private and technical spheres of rhetoric (Goodnight, 1982). This can be productive for enlarging the focus of PUS to include public scientific argument in realms other than science policy-related public engagement initiatives. I close the chapter by considering the persuasive potential of personal anecdotes in scientific arguments and the benefits of expanding PUS to include the everyday, noninstitutional scientific arguments of nonexperts.

In the third chapter, I analyze the institutional voice of Yosemite National Park by

examining texts it produces, including the park's website, interpretive and educational displays, and informational newspaper. I explore the multiple environmental discourses that constitute the park's polyphonic institutional voice, particularly the competing rhetorics of scientific rationalism, precaution, and apocalyptic. I theorize the role of the irreparable in the rhetoric of precaution and explore the implications of a present (rather than strictly future) apocalypse. I conclude the chapter by examining the consequences of embodied versus disembodied sources of climate change arguments and the persuasive potential of each of the rhetorics analyzed.

I conclude this thesis by synthesizing the theoretical and practical implications of the previous chapters, examining the ways in which these diverse articulations of climate change relate to one another. I argue that they reveal the many diverse sources and evidence for arguments about climate change, and together challenge the notion that climate change is merely a scientific phenomenon that is understandable only through technical knowledge.

Ultimately, my goal in this project is to enrich the study of climate change and science communication and provide practical insights into effective methods of climate change engagement in public lands and other settings. As a case study in individual, communal, and institutional articulations of climate change in a particular national park, I hope this thesis contributes to a greater understanding of the potential of connections to place as catalysts for ecological thinking and behavior. This, in turn, may contribute to the protection of public lands and, ideally, the larger global environment, from the already felt threat of climate change.

CHAPTER I

"GOD'S COUNTRY": SENSE OF PLACE, CLIMATE CHANGE ICONS, AND NARRATIVE ARGUMENTS AMONG VISITORS TO YOSEMITE NATIONAL PARK

In Yosemite National Park, warming temperatures have altered precipitation patterns and affected local plants and wildlife (Gonzalez, 2016). These shifts demonstrate that climate change is already having an effect in Yosemite, as it has in national parks across the country (Gonzalez, 2010). The local and current nature of climate change, however, is often lost in the typical representation of the phenomenon as a future-based event that is geographically and temporally remote (Hamblyn, 2009; Sheppard, 2011), a perception that hampers a sense of personal responsibility or efficacy (Schroth et al., 2014). Although a number of climate change communication scholars have attempted to remedy the perception of climate change as a geographically distant threat by emphasizing its potential to cause local effects in the future (Schroth et al., 2014; Sheppard, 2011; Uzzell, 2000), few have addressed the current nature of climate change. This neglect of the temporally urgent aspect of current climate change overlooks the possibility that it may *already* have caused visible local effects that are perceptible to members of publics. For example, Schroth et al. (2014) studied the effects of "an interactive educational game featuring 3D visualizations and simulation tools for climate change adaptation and

mitigation future scenarios" that depicted climate change effects on a particular local environment (p. 414). They found that playing the game increased a sense of local responsibility. However, this study, and others like it, configure climate change as an impending event whose effects are primarily yet to come, rather than a current event with already visible consequences. Presumably, 3D visualizations like those described by Schroth et al. rely on future event modeling based on the assumption that the local environment has not yet been visibly impacted. However, according to the National Park Service's chief climate scientist, national parks have already been impacted in both highly visible and less visible ways, and these changes are projected to continue (Gonzalez, 2011). For example, Yosemite's decreased snowpack has led to increased areas charred by catastrophic fires, and many of the park's small mammal populations have disappeared from their historic ranges, shifting upslope by approximately 500 meters (Gonzalez, 2011). Given the findings of Schweizer et al. (2013) that public lands are important sites for climate change engagement, it is worth exploring whether and how national park visitors perceive climate change effects as a current, rather than strictly future phenomenon, and the ways in which they make sense of climate change in a public lands setting.

Interviews with visitors in Yosemite National Park suggest that virtual visualizations may not be necessary to demonstrate the effects of climate change in the park. Visitors have developed their own personal vocabularies of local icons that function as metonymies for the larger phenomenon of climate change in Yosemite. Visitors who have longstanding relationships with the park draw on a more extensive array of icons to articulate the local effects of climate change, while other visitors rely on either non-locally specific icons, or draw on a set of images from their own home environments in

order to make connections between the global and local effects of climate change. I argue that 1) visitors' sense of place plays an important role in their use of climate change icons, dictating which kinds of images they have at their disposal; and 2) visitors rely on these icons to make narrative arguments about the significance of climate change to Yosemite's environment.

This finding is a significant departure from most existing research on public understanding of climate change, which has tended to emphasize that members of lay publics usually do not see climate change as a locally or personally relevant problem (Leiserowitz, 2005; Leiserowitz et al., 2014; Lorenzoni et al., 2007; Uzzell, 2000; Whitmarsh, O'Neill, & Lorenzoni, 2015). Amid calls to make climate change locally relevant and personally felt in order to prompt greater public concern and action (Hamblyn 2009; Schroth et al., 2014; Schweizer et al., 2013), it is important to examine the ways that some members of publics *already* perceive the effects of climate change at the local level. This chapter begins to do so by exploring how visitors to Yosemite draw on sense of place in a national park setting to invoke climate change icons that act as evidence in arguments about the nature of climate change. I begin with an overview of the concepts of climate change visualizations and iconography, sense of place, and narrative argument. I then describe the methods used to gather the data examined in this chapter, followed by an analysis of participants' articulations of climate change, which are rooted in sense of place and vary based on experience in the park. Finally, I examine the ways in which visitors use icons as evidence in narrative arguments about the nature of climate change as either threatening, benign, or ambiguous. The chapter concludes with a discussion of the implications of this analysis for climate change communication and the persuasive potential of climate change icons rooted in sense of place. This

chapter extends and brings together the literature on sense of place and climate change iconography, highlighting the role of verbally expressed images from the local environment in crafting narratively structured arguments about climate change. This is significant for climate change communication because it draws critical attention to the use of icons generated from local environments as mechanisms for assigning meaning to climate change. This, in turn, sheds light on the potential for sense of place in public lands to increase public climate change engagement.

Climate Change Iconography and Visualization

Climate change has long been perceived as a subject of public controversy that is fraught with challenges of representation and barriers to public understanding. The inability to predict precisely the exact effects of climate change means that uncertainty is inherent to any discussion of climate change as an event with future consequences. This contributes to the challenging nature of public understanding of climate change. According to Hamblyn (2009), "All narratives of climate change deal inescapably with uncertainty, whether they are supportive of the consensus scientific view or not, while detailed scientific claims and counter-claims only add to the sense of confusion apparently felt by lay audiences" (p. 224). Further, Nicholson-Cole (2005) has argued that the abstractness of climate change, along with its "long time horizons" "make it difficult to relate to and to see how personal efforts to reduce emissions might really have an effect" (p. 258). The abstract nature of climate change therefore makes it hard to concretize, further complicating public climate change engagement efforts. Kainulainen (2013) underscored the representational issues associated with climate change: "While all things, no matter how seemingly presentable...are fundamentally unknowable and thus

unpresentable, hyperobjects like climate change are so vast that they cannot be known except through their representations" (p. 118). Climate change, therefore, is experienced by individuals and visually and verbally represented in terms of its effects rather than as an entire phenomenon. This presents a challenge to the communication of climate change because no single set of representations of particular impacts is capable of conveying the complexity of global climate change or fully expressing the specific relationships between scientific processes and their direct effects.

In order to better grasp public understanding of climate change and the ways in which lay publics and the news media represent the phenomenon, climate change communication scholars have turned to climate change visualization as one area of study. Climate change visualization is the processes of depicting climate change as images. It can refer either to the visual motifs commonly used by the news media to portray climate change or to the mental images described verbally by members of publics when asked to describe climate change (Smith & Joffe, 2013). Media analyses of climate change depictions have found consistent reliance on images such as glaciers and palm trees (Brönnimann, 2002), the "combination of polar bears and melting ice" (Garfield, 2007), and images of abject human victims of climate change effects that represent vulnerability (Manzo, 2010). However, according to Uzzell (2000), these types of images—nearly always of far-away people and places—produce a distancing effect on viewers, causing them to see climate change impacts as more catastrophic the farther away they are, and to be unlikely to view themselves as personally affected or responsible. To combat this phenomenon and to make the issue more locally relevant to publics, a number of climate change communication researchers have explored other forms of imagery. For example, Smith and Joffe (2013) asked participants to "draw or write four spontaneous 'thoughts

or feelings' about global warming" and found that

> first thoughts, either drawn or written, often mirrored the images used by the British press to depict global warming visually. Thus in terms of media framings, it was their visual rather than their textual content that was spontaneously available for their audiences. (p. 16)

This study, and others like it, demonstrates that mental images of climate change effects, translated verbally, are an important element of public understanding and articulations of climate change.

Some climate change communication scholars have referred to climate change visualizations, including those produced by the news media and those produced by research participants, as "climate change icons" or "iconography." A climate change icon is any image, photographic or mental, that represents climate change within a society or to an individual (DeLuca, 2009; Hamblyn, 2009; Manzo, 2010; O'Neill & Hulme, 2009; Schroth et al., 2009; Smith & Joffe, 2013).[3] I rely on O'Neil and Hulme's (2009) definition of a climate change icon as

> a tangible entity considered worthy of respect; something to which the viewer can relate and for which they feel empathy (a climate icon then being an icon which will be impacted by climate change). This definition is informed by the way the term is used in areas such as religious artistry, information technology, semiotics, and in the popular media. (p. 403)

O'Neil and Hulme emphasized that climate change icons are invested with meaning by the individual, acting as mnemonic devices and signifying an important moment during which the individual perceived climate change. For example, they noted that "a particular

[3] This definition of icons is consistent with those used in the climate change communication literature. It differs from that used in visual rhetoric literature, which holds that iconic images are "photographic images produced in print, electronic, or digital media that are recognized by everyone" and produce social identification (Hariman & Lucaites, 2001, p. 7). Although research on climate change visualizations tends to use the term *icon* more broadly, there is a degree of overlap between these various uses of the term; Hariman and Lucaites (2001) argued that iconic images create "mnemonic materials" (p. 7), while Hatfield (2008) noted that iconic images "signify important moments or events," particularly moments of anxiety or turmoil (p. 67).

image of a drowning polar bear is not an icon (it is a representation of the icon); it is the conceptualisation of a polar bear (as perceived by an individual) which is the icon" (p 403, parentheses in the original). In other words, an individual's mental image of a drowning polar bear, which may be based on a photograph, a video clip, or a verbal or written description, is a climate change icon for that individual if he or she understands the polar bear to be an object worthy of respect and empathy and its fate to be a consequence of climate change.

Climate change icons are the result of the process of objectification (Breakwell, 2010; Hoijer, 2010), which is "translating something that is abstract into something that is almost concrete, gaining a density of meaning that ultimately makes it a common and 'natural' part of thinking about the object" (p. 865). For example, an individual might objectify climate change, an abstract notion, by describing it as warmer temperatures, extreme weather events, or melting ice caps. When these objects are translated into mental images or visualizations, they can become icons. For instance, the mental image of a hurricane might be a climate change icon for an individual who objectifies climate change as extreme weather events.

Personally held climate change icons, then, function on the level of the individual, but they are always the product of larger discourses. According to Kainulainen,

> While the effects of climate change may be physically experienced, our ability to give meaning to these various events, to name them as 'climate change,' depends on the discourse used to connect global events. These discourses name some elements while excluding others for ideological purposes. (p. 118)

Images of climate change in the news media, as well as scientific, religious, and economic discourses, all play a role in an individual's ability to name, objectify, and give meaning to the effects of climate change that he or she perceives (Nicholson-Cole, 2005).

The process of verbally invoking an icon allows a personally held mental image to function rhetorically in the articulation of climate change. This chapter focuses on such invocations, whereby climate change icons are translated from mental images into verbally expressed descriptions of and references to icons, which are used to verbally illustrate arguments about climate change.

Sense of Place and Climate Change Icons

Since climate change icons can relate to the local environment, they can be important elements to the process of endowing icons with personal meanings based on one's experience with that local environment. Sense of place is the foundation for the relationship between icons and the local environment. Sense of place is an "individuals' relationship with their surroundings" (Bricker & Kerstetter, 2000, p. 233) and is crucial to one's ability to understand the local effects of climate change. According to Relph (1997),

> Sense of place is first of all an innate faculty, possessed in some degree by everyone, that connects us to the world. It is an integral part of all our environmental experiences and it is only because we are first in places that we can then develop abstract arguments about environment, economy, or politics. But in addition to this, sense of place can be a learned skill for critical environmental awareness that is used to grasp what the world is like and how it is changing. (p. 209)

In this way, sense of place—particularly that which develops over a long period of time—is a key faculty for perceiving and understanding changes to the local environment, including the effects of climate change, and forming climate change icons from one's surroundings. A well-developed sense of place facilitates the ability to observe changes in one's surroundings and attribute meaning to those changes.

Climate Change Icons and Narrative Arguments

When changes to one's local environment become mental images associated with climate change, they can function as climate change icons and be invoked to make narrative arguments about climate change. I argue that climate change icons act as central characters in narrative arguments about climate change, because they are entities that change or demonstrate change over time and exemplify the meanings of climate change held by the narrator. They can thus be invoked as verbally expressed visual evidence in narrative arguments about the nature of change in a local environment. Gross (2009) has described a process wherein "verbal and visual elements [work] together to create an evidential basis for an overarching argument" (p. 164). The use of visual objects to back up larger verbal claims about the nature of climate change demonstrates the power of verbally expressed imagery and invocations of icons to act as evidence.

Icons are central to narrative arguments. According to Shen, Sheer, and Li (2015), "Narrative is an umbrella term for personal stories, exemplars, testimonials, and entertainment–education contents" and can include "anecdotes, testimonials, and other stories" (p. 105). An element of chronology is crucial to narrative, as narratives "are stories with plots and chronological sequences of events" (p. 106). Fisher (1984) has defined narration to include both "words and/or deeds—that have *sequence* and *meaning* for those who live, create, or interpret them" (p. 2, emphasis mine). The ability of icons to represent change over time, therefore, is key to their persuasive potential in chronologically driven narrative arguments about climate change.

Method

To better understand the ways in which visitors to Yosemite National Park express their perceptions of climate change, I conducted semistructured interviews with visitors throughout the park. I contacted participants in campgrounds, outside visitor centers, at trailheads and on trials, and in and around concessions in every major region of the park. In all, I conducted semistructured interviews with 40 visitors, five of whom were from other countries.[4] Because many people visit national parks as part of a family or friend group, a majority of respondents participated in group interviews along with the spouses, partners, friends, or family members with whom they were traveling. This facilitated a conversational dynamic, in which participants responded not just to me, but to one another, providing a relaxed atmosphere in which they could draw on shared contexts to articulate understandings of climate change. Interviews included questions about the participants and their relationship to the park, including where they were from and whether and how often they had previously visited Yosemite; whether they believed climate change would have an impact on the park and if so, how; whether they believed it had already had an impact on the park and if so, how; and whether they believed they had personally seen climate change impacts during their time in the park, and if so, what.

I obtained permission to record each interview and later transcribed these recordings. I used an inductive approach to find common themes among interviews. This revealed a widespread reliance on climate change icons, rooted in sense of place, to make narrative arguments about the nature of climate change. Below, I examine the icons invoked by visitors, paying special attention to the role of sense of place in mediating the icons

[4] Although this is a small sample of Yosemite's many visitors, it is a good starting point for understanding how visitors communicate about climate change in a public lands setting.

visitors used. I do not evaluate the scientific accuracy of participants' claims and icons, but instead focus on the ways in which arguments, levels of specificity, and affect varied based on the visitor's relationship with the park and perception of climate change.

Climate Change Icons in Yosemite

The visitors I encountered in Yosemite independently deployed an array of climate change icons that varied greatly in terms of their specificity. First-time or relatively new visitors tended to rely on icons that are not unique to Yosemite, or relied on icons from a home environment with which they were more familiar. By contrast, visitors with a more developed sense of place in Yosemite tended to use locally specific icons from the park's landscape, many of which were invested with personal meaning for the visitors who invoked them. In this way, sense of place played a significant role in dictating which icons participants had at their disposal. In this section, I offer examples of the general icons invoked by newer visitors to the park. I then explore the use of icons by visitors who used a sense of place in a home environment to make connections with Yosemite. Finally, I offer examples of the locally specific icons of longstanding park visitors who articulated a level of affect associated with the loss of particular park resources.

Many first-time visitors to Yosemite articulated a lack of familiarity with the park. These visitors tended to rely on more general icons that are found in many landscapes, such as water, waterfalls, plants, and animals. For example, a male participant staying in a park campground, who was visiting for the first time, said, "I'm sure the rivers and the waterfalls and, you know, the animal life and plant life has changed." When asked whether he thought climate change would impact Yosemite, a first-time, male visitor from Chile answered, "Probably deforestation, you know, loss of water, species maybe.

Basically.” A set of friends taking in the view at Glacier Point’s panoramic vista, all of whom were first-time visitors, offered the following responses: “I think there's potential for more dry seasons, which could affect the waterfalls and maybe the animals around, because you know, less water coming through, less animal action.” His friend added, “They're talking about less and less water.” “Less water, less vegetation,” his wife agreed. These examples of general icons stand in contrast to the icons invoked by visitors with a more developed sense of place in Yosemite, who used features specific to the park, such as particular waterfalls, rivers, and species, to act as icons. The use of more general icons suggests that these visitors perceive climate change to have consequences for the natural world writ large, but does not speak to the ways in which these consequences will play out in Yosemite specifically.

In each of these cases in which visitors invoked nonspecific icons, they also articulated a sense of unfamiliarity with the park and uncertainty about the role of climate change for the park. For example, the male participant in the campground qualified his response, saying,

> I'd have to, like, see the place [Yosemite] first, and then like, ponder that [climate change] over the next few months… I haven't seen it before… I'd have to see pictures before and after and, kind of study it a little bit.

The visitor from Chile added, “But I don't know how, like, I can’t see change, because it's my first time, right... Like I wouldn't know because I haven't been before.” One of the friends at Glacier Point said, “I feel like I would need to know more about what Yosemite was like 10 years ago, and I have no idea.” The sense of needing an understanding of Yosemite in the past as a baseline comparison point was a common theme among first-time visitors. Without a strong sense of place in the park, they were unable to deploy specific icons.

In conjunction with general icons that were not unique to Yosemite, many visitors who lacked a strong sense of place in the park used icons from their homes in order to make connections to a less familiar setting. For example, a first-time visitor from Maine, when asked if she thought climate change would impact Yosemite, immediately compared it to her home state, saying, “Oh! It's having an effect everywhere. I mean, it's obvious. Yes…the weather has completely changed!...I mean last year in Maine, we, half the state got snow and half the state didn't. And that’s ridiculous.” Another first-time visitor, a man from Norway, admitted that he did not know much about climate change in Yosemite, but that, “in Norway, we see the impact already… Glaciers melting, more vegetation at higher altitude where there's not been vegetation previously. That's changing.” The visitor from Chile said, “I've seen in my country, you know, different national parks and forests, beaches, everything, having changed throughout the years. So um, I don't think that Yosemite will be spared, right? Because it's the whole world.” These examples demonstrate that visitors use icons from a home environment to create connections to a less familiar location by making conjectures that Yosemite will see similar climate change effects as their home environments. Despite their lack of familiarity with the way Yosemite might have looked before anthropogenic climate change began to take a toll, these new visitors deployed their sense of place in a changing home environment as evidence for their claims that climate change would also have an unspecified impact on Yosemite. Sense of place in *any* environment, then, can be used to generate icons that may not be specific to a given environment but that nevertheless facilitate connections between different locations and claims about the effects of climate change.

In contrast to the newer visitors to Yosemite who drew on general natural features to

serve as climate change icons, longstanding visitors employed a much wider array of locally specific climate change icons in addition to the more general icons used by newer visitors. For example, a woman staying in a park campground drew on locally specific icons to articulate her perceptions of climate change, and expressed a level of affect connected to those icons that was unique to longstanding visitors. She and her partner described Yosemite as "God's country" and "our sacred place," saying, "It feels right here." This illustrates the affective element of sense of place, whereby "intense feelings" are associated with one's sense of belonging in a place (Rose, 1995, p. 89). This woman invoked an icon that was commonly referenced by longstanding park visitors: thousands of newly dead pines due to a recent infestation of a native bark beetle. This beetle's proliferation is enabled by the warmer winters and drought brought on by climate change, and has already wiped out 66 million trees in the Yosemite region, with no signs of slowing (Fettig, 2012; USDA Office of Communications, 2016). When asked about the effects of climate change she had seen in the park, the woman described her reaction to the dead stands of pines, saying, "We were driving in and I was like, 'Look at all these dead trees! Is this from the drought?'… It's *sad* to drive in, there were so many dead…Huge amounts of dead trees!" This participant linked the drought and the bark beetle with climate change, pointing to the resulting dead pines as a climate change icon. She not only invoked the death of a specific tree species, but also recounted a narrative that described her initial reaction upon encountering them, as well as her emotional response of sadness. She demonstrated her sense of place with her ability to observe change and associate that change with climate change and with personal meanings and emotion, saying, "Those trees, that was sad. I don't remember them like that last year even…I think it's way worse." In this way, she illustrated Relph's (1997) argument that

one's experience in a place over time facilitates the ability to make claims about the changes observed.

Perhaps the most specific and personally meaningful icon came from a participant who owns property in the park and has lived there part-time since the 1970s. In addition to his use of the icons of the dead pines and receding glaciers, he invoked as an icon a seasonal creek near his property and noted his personal relationship with it:

> There's a seasonal creek that used to flow by the cabin, and I could count on it every year when I came, I would see it flowing. I haven't seen it flow for the last 5 years. And I thought maybe this year, because of the more snow and rain, it'd be running this year, but no signs of it running at all.

Like many other participants, he linked the drought to climate change, and illustrated them both by describing the loss of a specific seasonal creek, as well as the precise number of years it has been dry. His feeling of being able to depend on the creek's presence was an important part of his sense of place, which had been altered by climate change along with his surroundings. His detailed awareness of the local environment served as evidence in his argument that climate change is impacting Yosemite and has already caused changes to the place.

It is important to note that some newer visitors to the park also invoked locally specific icons, although these invocations were tempered with a sense of uncertainty as to whether the object was an appropriate climate change icon. For example, one first time visitor to the park who was on an extended backpacking trip described seeing "all the dead trees along the way" on his drive into the park. However, he said, "I was thinking about, I wondered if it had always looked that way." Without a previous point of comparison, this participant was unsure whether he was perceiving the effects of climate change or seeing the park as it had always been. Visitors with prior experience in the

park, on the other hand, could point to the dead trees definitively as a recent phenomenon and invoke them as a climate change icon.

Longstanding visitors used climate change icons that are more locally specific and personally meaningful than newer visitors, who relied on more general icons. Many longstanding visitors invoked specific water features, particular plant and animal species, and exact locations in the park where they witnessed these icons. Many also described feelings of sadness and shock at the rapidly changing conditions they perceived, which aligns with O'Neil and Hulme's (2009) definition of an icon as an "entity considered worthy of respect; something to which the viewer can relate and for which they feel empathy" (p. 403). Unlike newer visitors, who described their inability to pinpoint climate change effects due to their lack of familiarity with the park, longstanding visitors often pointed to conditions from decades past as a baseline for comparison to currently changing conditions. Thus, the icons they invoked are contextualized by their personal histories and sense of place either in the park or in a home environment, illustrating the connection between sense of place and the use of particular icons. This aligns with Fishwick and Vining's (1992) argument that "landscapes embody meanings" (p. 57) and that one's sense of place is "heavily influenced by past experience" there (p. 62). Sense of place, born out of affective connection and personal history in a particular location, is associated with the process of assigning meanings to that location. For long-standing visitors to Yosemite, elements of the local landscape embodied meanings associated with climate change, including loss and sadness. These visitors used icons, facilitated by their long histories in the place, that were personally connected to a sense of a changing environment based on shifts they had observed over time. When visitors lacked past experience in Yosemite, they drew on experience in a home environment to articulate the

particular meanings they assigned to climate change. In this way, all visitors who believed climate change would have an effect in the park used their sense of place to produce icons that allowed them to make claims about the nature of climate change and its effects in Yosemite.

Icons as Arguments

Visitors not only used icons, which varied based on sense of place in Yosemite, to express perceptions of climate change, but also used those icons to make arguments about the significance or insignificance of climate change on Yosemite's environment. Those visitors who expressed concern about climate change as a catastrophic phenomenon invoked icons that suggested vulnerability and loss, while those who were unconcerned about it drew on icons that evoked resilience and natural, cyclical changes. Visitors who were unsure about the role of climate change in shaping Yosemite relied on more ambiguous icons of change that may or may not be climate change icons. All of these icons acted as evidence in verbal-visual arguments about the nature of climate change as well as serving as central characters in narratively structured arguments about the ways in which climate change will play out. The invocation of icons represents a form of narrative argument that is "descriptive, as it offers an account, an understanding, of an instance of human choice and action, including science" (Fisher, 1984, p. 9). In this way, visitors used icons to offer arguments in the form of accounts of climate change, which is, by its very nature, chronological. They used icons to substantiate claims about the nature of climate change by offering an interpretation of the icon invoked so that it served as evidence in their arguments.

Visitors who articulated concern over perceptions of climate change impacts in the

park invoked climate change icons that represented vulnerability, loss, and instability. In addition to the "sad" loss of thousands of pines and a personally meaningful creek, other climate change icons in this category included fire, visible effects of drought, and extreme weather events, which visitors used to argue that climate change will have rapid, dramatic, and far-reaching consequences. For example, a first-time visitor to Yosemite, who was exploring a grove of giant sequoias, said he believed climate change would impact Yosemite in a number of frightening ways:

> …the storms are getting worse, our dry seasons are less (wet) and longer, and it seems like there's, like more rash change, quicker… At least that's what we notice in the Midwest…A couple places we drove through it looked like entire hillsides had been completely wiped out (by fire).

Unpredictable and extreme weather events, harsher droughts, and fire are all frightening icons, drawn from his sense of place in a familiar home environment as well as from Yosemite's environment, that create a sense of vulnerability both for humans and nonhuman nature in the park. Each of these is characterized by "rash," quick change that is unpredictable and difficult to guard against.

Another visitor invoked a diminishing snowpack as a climate change icon to argue that losses related to climate change will be dramatic and permanent: "I would imagine that all of the snowpack is gonna be probably drastically changed, and all the animals and fish that depend on that stuff, and I mean, probably everything." Another participant, a longstanding visitor from a nearby community who believed climate change "already has" had an impact on the park, invoked a shrinking glacier, one of two remaining in the park, to make an argument about the fast pace of climate change: "I've read a little bit…about the glacier that's here somewhere in the park, that's dissipating *rapidly*." He also noted that climate change poses a risk to certain forms of recreation in the park,

saying, "…the previous year it was so dry. Hiking in the high country was really hard in the sense that, to get clean water, you had to really pay attention to where you were going." In this way, icons were used as focal points in arguments about the nature and ongoing effects of climate change.

These icons tell a story of ongoing global degradation. Things used to be one way, and now, because of climate change, they are different. The icon of the shrinking glacier, for example, demonstrates a clear chronology: there was a sizeable glacier in Yosemite's high country, and now, because of climate change, it is smaller. It will continue to dissipate "rapidly" as climate change continues to unfold. This narrative uses the shrinking glacier as a central character to argue that climate change has already made changes in the park, and will continue to do so at a swift pace. In the same way, the visitor from the Midwest used a charred hillside as an icon to demonstrate that one area of the park, which used to be lush, has now been "wiped out" by fire, which he argued is a consequence of climate change. In these narratives, loss and devastation are key themes, illustrated by icons that exemplify permanent change and irreparability.

Each of these climate icons evokes a sense of irreversible change to the environment and to the ways humans encounter the park. All of them represent a dimension of visual or recreational impoverishment, by which visitors will lose sights and experiences they value, be it waterfalls, greenery, animals, glaciers, or high country hiking. Visitors who were concerned about climate change used these icons of vulnerability, loss, and instability to construct arguments that climate change is a serious, rapidly moving, and far reaching threat, whose consequences are permanent. In this way, they drew on loci of the irreparable, whereby the icons invoked have "consequences [that] may cause an irreplaceable loss" (Cox, 1982, p. 227); once lost, there will be no way to recover these

objects. Perelman and Olbretchts-Tyteca (1969) pointed out that irreparability provides powerful grounds for argument due to the fear of permanent loss of precious objects and foreclosure of the possibility of a different choice in the future. Thus, visitors who were concerned about the effects of climate change used icons to make arguments about the irreversible nature of climate change consequences and the losses they believe it will bring.[5]

Not all visitors were concerned about anthropogenic climate change in Yosemite, however. Some viewed climate change as an inevitable, cyclical phenomenon, caused entirely or primarily by nonhuman natural forces. These visitors also drew on icons to act as evidence to support their claims about the benign character of climate change, including ancient glaciers that were gone long before humans could begin to affect the climate, as well as natural cycles of tree mortality. For example, one couple enjoying Yosemite's high country believed that the notion of anthropogenic climate change is "bogus." The man argued that "the climate is constantly changing" and that "the earth adapts" to these natural changes. The woman added, "It's changed before and it will change again." As evidence for the nonanthropogenic nature of climate change, the man drew on the ancient glaciers that carved out Yosemite Valley and shaped much of the region's landscape tens of thousands of years ago. "Just like when the glaciers came through and did their thing," he said. "Yeah. It'll adapt."

Another visitor invoked the icon of dead pines as evidence that visible environmental changes in Yosemite are not caused primarily by climate change. This visitor believed that drought and climate change are "cyclical. The earth's just going through its cycles."

[5] For a more in-depth discussion of the irreparable as it relates to climate change in Yosemite, see Chapter III.

As evidence to support this claim, he stated,

> I do notice a lot of beetle-killed trees. That was my major, forestry. I know the beetles are hitting, but they're hitting everywhere. Montana I know is getting hit huge. But I think it's more cyclical… I think that's the natural process of forests.

This visitor perceived the beetle-killed trees as a symbol of a longstanding and widespread cycle of natural thinning in response to overly dense forests. He established his credibility by citing his background in forestry, and used the significant beetle infestation in Montana to argue that forests "everywhere," not just those in Yosemite, go through these cycles.

These icons of ancient glaciers and beetle-killed trees are used to illustrate natural, cyclical change. They serve as evidence that current visual impacts to the park are all elements of an ongoing cycle that is part and parcel of Yosemite's character and history. These arguments suggest that Yosemite's environment is resilient and therefore stable on a long timeline, and that any current changes will be part of a temporary phase that has existed before in Yosemite's past. These participants made narrative arguments centered on long, continuous change to argue that current trends are natural and benign. The man who believed that climate change is "bogus" presented a claim about the ongoing nature of climate change, saying, "The climate is constantly changing." His evidence was a narrative about past climate regimes in which ancient glaciers are the main character: "Just like when the glaciers came through and did their thing." Likewise, the visitor discussing the beetle infestation told a narrative about other environments that have seen similar outbreaks, using dead pines as the focal point in a long chronology of death and regrowth that is not unique to the Sierra Nevada. For those who deny anthropogenic climate change, the chronologically driven narratives of ancient ice ages giving way to warmer climate regimes and cyclical beetle infestations functioned as an argument that

current shifts are nothing to worry about.

Some visitors were unsure about the role of human activity in causing climate change, while others believed it to be the result of some combination of natural cycles and human activity, the ratio of which is impossible to determine. These visitors drew on objects that have an ambiguous relationship to climate change, and which therefore may or may not be climate change icons. These objects are still icons—"a tangible entity considered worthy of respect" (O'Neil & Hulme, 2009, p. 403) that represent *some* kind of change, but whether that change is climate-related remains uncertain.

The most commonly invoked ambiguous object was the drought, which has been ongoing in the Sierra Nevada since late 2011. Visitors frequently turned the drought into an icon by linking it with its visual impacts, including brown vegetation, dead pines, and fluctuating river and waterfall volumes. For example, when I asked one participant whether he thought climate change had impacted Yosemite, he answered,

> I don't know how much you attribute to climate change and how much you attribute to other stuff…The trees have withstood a lot of different stuff— the fires that they had with the drought. You know, the forests come back. But it's still devastating.

Another visitor expressed similar uncertainties about climate change as it relates to the current drought, saying,

> I mean, there's [sic] many, many dead trees. It's obvious. We are in a serious drought. I don't know how long it's gonna last, but is it cyclical? Are we gonna come out of it? Or is it gonna get worse and worse and worse? I don't really know. My opinion is, through the years, there have been droughts. Is this one different than other droughts? I'm not sure. Is it gonna last longer, or is it gonna stop? I don't know.

Another visitor cited widespread brown vegetation as an ambiguous icon. He noted that Yosemite Valley was "not as green" as it was during a previous visit years ago. He was uncertain of the cause of this change, however, saying, "I don't know if it was climate

change, or just a natural occurrence. I mean, just the cycle of life." These visitors believed that the drought, which they turned into an icon by linking it with visuals like the "many, many dead trees" and lack of greenness in the park, may or may not be related to global climate change. These symbols are therefore icons of change, but this change may be typical of California's drought cycle, or it may be the result of larger, long-lasting shifts caused by climate change.

These ambiguous icons play a distinct role in narratively structured arguments about the nature of climate change. While these icons do act as characters that illustrate change, the central characters are not the icons, but the humans who are unable to determine what the icons mean. After each use of an icon of ambiguous change, participants added sentences such as, "*I* don't know if it's climate change." In this way, the focus of the narrative became the human who observes but cannot interpret a changing environment, while icons acted as supporting characters that demonstrated those changes without revealing their causes. These icons' primary meaning is simply change, rather than the deeper meanings of loss or resilience that participants assigned to icons of destructive or benign climate change. This demonstrates that the ability to generate icons of change from the local environment is not always connected to the attachment of deeper meanings to those icons. A rhetor can use an element of the surroundings to symbolize change and stand in for the larger phenomenon of a shifting environment without investing that icon with great personal significance or definitive deeper meanings. This is an important counter-example to the uses of icons that were linked both to affect and to clear arguments about the nature of climate change. Instead, they can also be used to represent uncertainty or confusion.

Whether visitors assigned meanings of loss, resilience, or confusion to the icons they

invoked, the process of drawing on the local environment to generate narrative arguments about the nature of climate change is strongly connected to sense of place. According to Relph (1997), sense of place is the basis for understanding "what is good and what is bad in places" (p. 209). Participants made arguments about whether the climate-related changes they saw were good, bad, neutral, or mysterious based on their understandings of both the local and global environment. For visitors who saw dry, brown landscapes and rapidly dissipating glaciers as distressing signs of fast-moving climate change, sense of place allowed them make comparisons between the way the park looks currently and the way they remembered it looking in the past or the way a home environment looked in the past. They then assigned meanings of loss, sadness, and irreparability to particular icons that exemplified these changes. For visitors who saw the current state of the local environment as natural and normal, they made comparisons to much older landscapes, drawing on their understanding of ancient climate regimes to assign meanings of harmlessness, resilience, cyclicality, and optimism. Visitors who invoked ambiguous icons attached them to a sense of uncertainty about the role and reality of climate change, fitting them into a larger cultural narrative about the scientific uncertainty inherent in the study of climate change (Ceccarelli, 2011; Walsh, 2010). In all three cases, sense of place is the basis for observing one's surroundings, fitting those observations into a larger framework of understanding, and assigning meaning to those observations.

These examples illustrate the argumentative potential of icons, which can act as evidence for the narrative claims visitors present regarding the nature of climate change as devastating, benign, or ambiguous. The availability of icons for the constructing of arguments based on sense of place exemplifies Fisher's (1984) notion that narrative provides "a radical democratic ground for social-political critique" (p. 9). Icons from

local environments are available to anyone who wants to make arguments about climate change, whether they are experts or not. Most visitors I interviewed claimed not to know much about climate change, particularly climate change in Yosemite; none claimed to be experts. Yet they were able to draw from the local environment, their home environment, or both, in order to find icons that enabled argumentation about the nature of climate change. Thus, the accessibility of icons enables observation-based narrative argument by members of lay publics.

The crafting of arguments out of readily available icons from the surrounding environment depends on the meanings attached to those icons. The fact that the same icon could be used to make mutually exclusive arguments illustrates Condit's (1990) assertion that images on their own are not propositional, but rather depend upon the verbal to make them capable of argumentation. For example, one visitor cited a "rapidly" dissipating glacier as evidence that climate change is already having fast-moving effects on the park, while another visitor pointed to "the glaciers that came through and did their thing" in the past to argue that climate change is part of a natural cycle. In the same way, one visitor invoked beetle-killed trees to argue that changes to forests are cyclical and natural, while another used the same icon to argue that it is impossible to tell whether the drought that enabled the die-off might be similar to previous regional drought cycles, or more long-lasting and related to global climate change. While these icons do serve as evidence, they depend on verbal arguments to do so, demonstrating the multiple meanings possible for any given icon. Those meanings must be made explicit in order to construct an argument using icons. A melting glacier does not, on its own, serve as evidence that climate change is devastating or benign or the result of natural versus anthropogenic activity. For the participants who used melting glaciers as evidence that

climate change is already happening and has devastating consequences, they did so in response to the question, “Do you believe climate change will have an impact in Yosemite?” Their claim that it “already has” is backed up by evidence in the form of glaciers that have already dramatically receded. By contrast, the participants who made the claims that “climate is constantly changing” invoked the icon of ancient glaciers as evidence that Yosemite has had a long and varied climate history. In each of these cases, the icons were used as evidence for clearly stated claims about the nature of climate change, demonstrating that icons rely on interpretation on the part of the rhetor in order to be persuasive.

Implications

This chapter offers a number of practical implications for climate change communication. It demonstrates the potential of local environments and public lands as sites for public climate change engagement where visitors can be prompted to think about and discuss the climate change effects they already see. This analysis therefore not only offers a framework for examining the relationship between icons, sense of place, and argument, but also draws critical attention to the articulation of climate change as a current, as well as local, phenomenon. This is an important departure from dominant conceptions of climate change as a primarily future-based event and reveals the significance of national parks as sites that highlight the immediacy of climate change.

Specifically, this analysis explores the ways in which visitors to Yosemite articulate their perceptions of climate change as both locally and currently relevant. Although not all participants believed climate change to be anthropogenic or threatening, many of those who did pointed to elements of their immediate surroundings as evidence of the

changes already taking place. This finding stands in contrast to the research that indicates that members of lay publics do not perceive climate change as locally relevant. Sheppard (2011) argued that "few people have much idea how climate change will affect them personally" (p. 3). Visitors to Yosemite, however, not only have an idea how climate change *will* affect them and their national parks, but also how it *already* does. Their use of icons from the local environment or a home environment indicates that they have concretized the effects of climate change by attaching those effects to elements of their surroundings.

It is particularly notable that the icons deployed by visitors to Yosemite were spontaneously generated; unlike most existing research on climate change icons, I did not ask visitors to picture or imagine climate change. Rather, I asked them how they thought climate change would have an effect on Yosemite and what effects they believed it had already had. Participants' use of images and tangible objects to convey their perceptions of climate change occurred naturally and independently, demonstrating that climate change visualization does not have to be explicitly prompted in order to occur, and that visual imagery in the form of icons is an important way for members of publics to articulate their perceptions of climate change as a current and local phenomenon.

Next, this chapter highlights the role of sense of place in the deployment of climate change icons. Visitors with longstanding and deep relationships with Yosemite had at their disposal a wide array of icons unique to the park's environment, many of which were invested with personal significance and affect. These visitors were better equipped to offer specific observations of the ways the landscape has changed over time, and many attributed those shifts to climate change. Visitors who lacked a detailed awareness of Yosemite's environment, on the other hand, expressed uncertainty about the ways in

which climate change has impacted the park. They tended to rely on general icons, such as wildlife and water, which are not specific to Yosemite, or to draw on comparisons to a home environment, where they had a better developed sense of place, to depict the effects of climate change. This illustrates the importance of sense of place for making climate change visible in a particular setting, and also demonstrates that sense of place in any location can be useful for understanding climate change in other settings.

Finally, this analysis examines the use of icons as evidence in narrative arguments about the nature of climate change. Icons can function as verbal renderings of visual arguments that climate change is devastating, benign, or ambiguous, by serving as examples of the ways in which climate change has or has not had a significant impact on the local environment. The ability to draw on one's immediate surroundings to craft arguments opens up greater possibilities for scientific argument based not only on technical expertise, but also on sense of place. Like other forms of visual evidence, though, icons must be interpreted in order to function persuasively, since a given icon can have multiple meanings. In this way, personal interpretations of climate change and its effects can be deployed as arguments by laypersons.

It is important to note, however, that participants' ability to use icons to form arguments was not a guarantee of their understanding of climate science. Many participants used icons with an ambiguous relationship to climate change in order to argue that climate science is uncertain or that it is impossible to know how climate change impacts a given location. Others used icons in such a way that they came to represent normal, natural cycles of change and resilience instead of catastrophic anthropogenic climate change. More research is needed to begin to understand how icons and sense of place can be used to engender more productive understandings of the

science of climate change. More research is also needed to address the limitations of the small sample size of this study. As a rhetorical project, it provides useful insights on the relationship between sense of place, climate change icons, and arguments about climate change in a public lands context. However, more quantitatively oriented research could show whether these findings hold across larger numbers of visitors to public lands.

Conclusion

Scientific research suggests that climate change will have and has already had profound impacts on Yosemite's snowpack, high-elevation flora and fauna, and fire activity (Gonzalez, 2016). While national parks and wildlife refuges are promising sites of public climate change engagement (Schweizer et al., 2013), so far, little research has explored the ways in which national park visitors perceive and articulate climate change in public lands settings. This is a significant gap in the literature, given the importance of local and personal framing of climate change in order to elicit greater public engagement with the issue (Breakwell, 2010; Lorenzoni et al., 2006; Nicholson-Cole, 2005; O'Neill & Hulme, 2009; Schroth et al., 2014; Shaw et al., 2009; Sheppard, 2011; Smith & Joffe, 2013.)

This chapter has laid out the ways that visitors to Yosemite National Park draw on home and park environments, either in general or specific ways, to generate icons for use in narrative arguments about climate change. This is an important illustration of the ways that visual elements of the immediate environment can be used to concretize and localize climate change. Furthermore, this chapter sheds light on the ways in which members of publics connect climate change to a national park setting and shows the potential of public lands as sites of intellectual and emotional engagement with the issue.

As climate change continues to move from a largely future-based event to a current phenomenon, individuals will have an ever-increasing number of icons at their disposal, which can be used to characterize and make arguments about climate change. Understanding the use of icons in this way is a crucial first step toward understanding whether and how climate change visualizations can lead to sustainable action, which may eventually help to limit the rapid accumulation of resources devastated by climate change and ripe for use as climate change icons.

CHAPTER II

"FACTS AS WE SEE THEM": EMPLOYEES' PERSONAL NARRATIVES AS EVIDENCE IN SCIENTIFIC ARGUMENTS ABOUT CLIMATE CHANGE

Yosemite National Park is 748,436 acres—nearly the size of the state of Rhode Island. To staff this considerable acreage, the park relies on 800 permanent, year-round employees and an additional 400 seasonal employees in the busy summer months, during which time over 20,000 visitors enter the park every day (National Park Service, 2015; Yosemite National Park, 2016). At the front lines of interaction with the public are interpretive park rangers—there were 56 during the summer of 2016 (B. Loudon, personal communication, October 5, 2016)—who are tasked not only with providing relevant information to visitors, but also serving as the face of the National Park Service to the public. Interpreters interact directly with visitors in a variety of ways, including basic orientation to Yosemite, giving information about specific park resources, and leading formal interpretive programs such as guided hikes and campfire talks. Interpreters' knowledge of the park is expected to be broader than it is deep, as they are required to speak on a great variety of topics, from park history to local ecology to geology and beyond. In keeping with this breadth of duties, an educational background in the sciences is not required to be an interpretive ranger in the National

Park Service; nearly any bachelor's degree will do (U.S. Office of Personnel Management, 2016). Yet interpreters inhabit a unique position somewhere between layperson and scientific expert. According to their job description and the expectation of park visitors, they must be able to interpret science related to the park, but many lack formal technical training in the sciences. For example, only two of the six interpreters in the region of Yosemite where I work have degrees in one of the hard sciences.

With or without technical training in the sciences, interpreters in Yosemite frequently address a number of scientific topics, including climate change, in response to questions from visitors about the topic, and often as part of their formal programs. In this capacity, they must represent the National Park Service's position on climate change, which has changed over time. Compounding the complications of interpreting climate change in the face of changing policy, ever-developing climate science, and public perceptions of the subject as controversial (Banning, 2009; Ceccarelli, 2011), Yosemite's interpreters are also private citizens with personal views on the issue, as well as residents of the park who have deeply felt connections to the local landscape and first-hand experience with Yosemite's resources and changing conditions. This places them in a unique position to provide scientific information, often without in-depth technical training, as well as personal testimony about climate change based on lived experience. Employees' combination of scientific knowledge and personal testimony creates a distinct rhetoric that blends narratives of local knowledge with scientific knowledge. This blending of local and scientific knowledge brings together the personal and technical spheres of rhetoric (Goodnight, 1982), combining discourses that are not traditionally employed together. Such blending is explicitly employed as a form of argument, meant to persuade publics that climate change in Yosemite is a real, anthropogenic threat with already-

visible impacts. These hybrid arguments of local and scientific knowledge demonstrate that distinctions between the public, private, and technical spheres are easily blurred (Crick & Gabriel, 2010; Jackson Jr., 2006; Keränen, 2005; Rowland, 1986) and that such blurring can be productive for persuasive climate change communication.

Although a number of scholars have demonstrated that forms of argument can be blended, the particular ways in which rhetors express blended local and scientific knowledge has yet to be thoroughly explored. Rhetorical analysis of this blending can reveal the ways in which local and technical forms of knowledge are brought together and expressed, and can shed light on the persuasive potential of such blending. Jackson, Jr. (2006) has argued that the separation of personal, technical, and public forms of argument "is neither possible nor enlightening" (p. 16), and Endres (2009) has complicated the distinction between technocrats and laypersons, revealing that "citizens are capable of making scientific arguments" (p. 51). To expand this area of study, the blended arguments of Yosemite's interpreters represent an important case study on the integration of local and scientific knowledge and the use of both forms of knowledge in combination to make scientific arguments.

This chapter contributes to the literature on public understanding of science (PUS) and climate change communication by exploring the ways in which nonscientists articulate scientific expertise—that is, a working knowledge of scientific concepts related to the local environment gained from educational background, on-the-job training, or self-teaching (Kinsella, 2004). In the case of national park interpreters, I argue that nonscientists with some scientific expertise use place-based anecdotes as evidence for scientific claims regarding climate change, using narrative as a bridge between the personal and the technical to create arguments that blend the two spheres.

In order to study the ways in which national park interpreters construct scientific arguments using narrative anecdotes based on local knowledge, I weave together a framework that draws from the literature on anecdotes as narrative testimony, local knowledge based on sense of place, and public understanding of science. This framework is uniquely suited to provide insight into the ways in which nonscientist members of publics draw on multiple forms of knowledge to create blended arguments about the nature of climate change, challenging the distinctions between the private and technical spheres of rhetoric. I begin with an overview of the relationship between narrative, local knowledge, sense of place, and spheres of rhetoric. I then describe the method used to gather the interviews I analyze in this chapter, and then offer an analysis of the particular scientific arguments and place-based narratives of Yosemite's interpreters. The chapter concludes with a discussion of the implications of this analysis for public understanding of science and climate change communication. For PUS, the chapter draws attention to the rarely examined potential of hybrid arguments constituted by both scientific and local knowledge, which blur the boundaries between the private and technical spheres. It also expands the focus of PUS to include the persuasive scientific communication of publics outside the realm of public participation and scientific decision-making. For climate change communication, my analysis expands the concept of narrative as testimony of climate change to explore the use of narratives as evidence for broader scientific arguments. It also bring together the literature on local knowledge, sense of place, and climate change communication to explore the ways in which local, place-based testimonies combine to create a collective narrative of lived climate change experience.

Narrative, Local Knowledge, and Sense of Place

Personal testimony is crucial in making climate change comprehensible and narratable because it moves climate change out of the realm of the theoretical and abstract, into the realm of lived experience. Despite the representational challenge of climate change (which was discussed in the previous chapter), "its visible effects on the ground can be converted into first-person testimonies, and its truth established not only by the pronouncements of climate scientists, but by the power of a collective narrative" (Hamblyn, 2009, p. 232). According to Chouliaraki (2016), the narrative structure of testimony is constituted by eye-witnessing and bearing witness. Eye-witnessing is providing "descriptions of actual experiences," while bearing witness is "reflexive evaluations" of those experiences (p. 62). In the case of the Yosemite interpreters I interviewed, eye-witnessing comes in the form of anecdotes of climate-related environmental changes participants have personally experienced, while bearing witness occurs when those anecdotes are linked to larger scientific claims and meanings assigned to climate change.

Anecdotes are a particular form of narrative that "present the history or experience of a particular person or case" (Greene, Campo, & Banerjee, 2010, p. 112) and can be an effective form of persuasion because of their "capacity to vivify [and] to personalize…rather than simply exemplify general themes" (Oldenburg, 2015, p. 104). By providing and interpreting anecdotes, an observer of climate change positions him or herself as "a thinking and feeling agent who shares his experience with others and invites those others to give a moral response to his testimonies" (Chouliaraki, 2016, p. 60).[6]

[6] Chouliaraki was examining the war testimony of male soldiers and therefore used the male pronoun. However, her framework can also be applied productively to climate change testimony.

Yosemite interpreters share experiences of personally felt climate change effects to advance a scientific claim about the nature of climate change, with the often explicit goal of prompting a moral response of sustainable action among audience members, resulting from acceptance of these claims.

Personal anecdotes are a crucial element of testimony, because they convey the authority of the eye-witness. Much work has been done to identify the role of narrative structure in scientific discourse (Barton & Barton, 1988; Myers, 1990; Norris et al., 2005; Sheehan & Rode, 1998; Spoel, Goforth, Cheu, & Pearson, 2008); however, little work has been done to address the role of anecdotes—a literal form of narrative—in scientific discourse. Many scholars who argue that narrative plays a significant role in scientific materials define narrative broadly as pieces of discourse that have a sequence of events and address the meanings of those events (Fisher, 1984; Sheehan & Rhode, 1998). Certainly, arguments about the nature of climate change adhere to this definition of narrative (see Chapter I). However, Yosemite's interpreters not only employ arguments characterized by chronology and interpretations of meanings, but also use narrative in the form of anecdotes to illustrate changes in the local environment and to act as evidence for claims that climate change is real and anthropogenic. As residents of the Yosemite region with a working knowledge of the park's ecology and an intimate familiarity with conditions on the ground, Yosemite's interpreters are well situated to provide anecdotes of the changes they have witnessed.[7]

These anecdotes of witnessed change in the park can serve as a form of local

[7]As in the previous chapter, I do not evaluate the scientific validity of the claims participants have made. Instead, I am interested in the ways in which they communicate their understanding of science and craft blended scientific arguments using multiple forms of knowledge. Regardless of the scientific validity of these arguments, participants' use of particular elements of the local environment creates a powerful argument based on tangible, observable losses.

knowledge expressed narratively. Fischer (2000) has defined local knowledge as "knowledge about a local context or setting, including empirical knowledge of specific characteristics, circumstances, events, and relationships, as well as the normative understandings of their meaning" (p. 146). According to this definition, scientific training is not necessary to have expertise related to the changing conditions of one's immediate environment. Fischer went on to note that this "informal, contextual, local knowledge [is] often organized in narrative form and told as stories" (p. 179). According to Baake and Kaempf (2011), narrative is an important source of reasoning and resource for expressing local knowledge for stakeholders in environmental decision-making. They have argued, "In narrative individual experience is linked with a region's physical features" (p. 431). Furthermore, "people simultaneously draw on story lines and on technical data" to understand their environments (p. 433). Thus, multiple forms of knowledge are useful for comprehending and making arguments about a given place, which are often conveyed as narrative. In order to tap into local knowledge about particular environments, therefore, it is important to attend to the narratives told by members of publics who have local experience with those places.

Narrative is also a key element in the understanding and articulation of sense of place, which is integral to local knowledge and constituted, in large part, rhetorically. Sense of place is comprised of "affective ties with the material environment" (Tuan, 1990, p. 93). Cantrill and Senecah (2001) have linked sense of place with discursive practice, arguing that "sense of place is the perception of what is most salient in a specific location, which may be reflected in…how that specific place figures in discourse" (p. 187). Carbaugh and Cerulli (2013) argued that "our communication is playing a formative, constitutive role in creating our sense of place" (p. 7). They have called this rhetorically constituted sense of

place “cultural discourses of dwelling” and explore a number of relevant discursive practices, including “verbal depictions of place, formulations of locations, giving directions, symbolic representations of animals, topographic depiction, various sorts of visual communication, and the like” (p. 11). Sense of place is developed over time (Carbaugh & Cerulli, 2013; Tuan, 2001) and is the basis of the ability to “understand and process various claims and arguments regarding the human relationship to and responsibilities for managing the natural world” (Cantrill & Senecah, 2001, p. 185). Therefore, sense of place as an intimate understanding of one’s environment serves as the foundation for local knowledge, which is often constituted and expressed as narrative in the form of anecdotes whose setting or focus is the particular place.

Interpreters in Yosemite demonstrate that local knowledge is both individual and relational. Their testimonies of climate change are often deeply personal and centered on their experiences as individuals in specific physical locations. These personal narratives of place, however, combine to create a collective narrative of lived climate change experience in Yosemite, or a form of local knowledge, which is distinct from the scientific data they cite regarding the phenomenon of climate change. Sense of place is usually said to be possessed by individuals (Cantrill & Senecah, 2001; Tuan, 2001), while many scholars conceive of local knowledge as the property of communities (Basso, 1996; Canagarajah, 2002; Carbaugh & Cerulli, 2013). Others, however, understand local knowledge to exist on the individual level as well (Fischer, 2000; Raymond et al., 2010; Taylor & de Loë, 2012). While Carbaugh and Cerulli (2013) emphasized the relational and communal nature of cultural discourses of dwelling, they also located particular discursive practices in the communication of individuals. The climate change anecdotes of Yosemite interpreters function on both individual and communal levels because they

demonstrate personally held local knowledge and come together to create a collective narrative of climate change.

The local knowledge of Yosemite interpreters serves as the foundation not only for their collective narrative of change, but also for the scientific arguments they make about climate change. According to Goodnight (1982), scientific arguments belong to the technical sphere of rhetoric, which requires "specialized forms of reasoning" (p. 218). He argued that the technical sphere is discrete from the private and public spheres, which are concerned with the personal and the social and cultural, respectively. Similarly, Wynne (1991) defined public understanding of science as "an interactive process between lay people and technical experts" (p. 114). However, Yosemite's interpreters complicate these boundaries, and the profession of national park interpretation problematizes the distinction between lay people and technical experts. Their job is to interact with visitors and speak on a variety of topics including, but not limited to, the science of the park. They are not full-time, professional scientists or researchers, but are tasked with interpreting scientific topics. This suggests that the categories of scientific expert and nonexpert are somewhat fluid. I refer to the Yosemite interpreters I interviewed as nonexperts or nonscientists because formal technical training is not a requirement to be National Park Service interpreters.

Furthermore, the hybrid arguments of Yosemite's interpreters demonstrate that the discursive requirements of each rhetorical sphere are not as distinct as Goodnight has described them to be. Keränen (2005) and Crick and Gabriel (2010) argued that the boundaries between public and technical spheres can be productively challenged for the benefit of stakeholders and in questions of science policy. Rowland (1986) has demonstrated that public argument can be highly technical. Jackson, Jr. (2006) has

demonstrated the role of the personal in scientific arguments in the form of ad hominem attacks. In this vein, my analysis builds on this previous research to demonstrate that personal anecdotes of lived experience can play an important role in scientific arguments, with narrative acting as a bridge between the personal and technical spheres.

Method

In order to better understand the ways in which interpreters in Yosemite National Park make arguments about climate change using local and scientific knowledge, I conducted semistructured interviews with interpreters working in each major region of the park. I recruited participants using the network of contacts I have established over my nine seasons of employment in Yosemite. I also asked each district supervisor to notify their staffs about my study, and was in turn contacted by employees who wished to participate. This strategy was in effect a form of criterion sampling (Lindlof & Taylor, 2011), as my contacts already met the criteria of employment as interpreters with the National Park Service.

In all, I conducted in-depth, semistructured interviews with 10 interpreters, representing each of Yosemite's four districts.[8] Participants' tenure with the National Park Service varied, ranging from one season to over 20 years, which provided a diversity of perspectives on the changing environment of the park. In addition to questions related to the participants' length of employment in Yosemite, interviews included questions about whether they believed climate change would have an impact on

[8] As in the previous chapter, this research is limited by its small sample size. Although ten out of 56 interpreters working in Yosemite in 2016 represents a significant percentage of the staff, additional research with a greater number of participants would be helpful to understand how widespread these findings are.

the park and if so, how; whether they believed it had already had an impact on the park and if so, how; whether they believed they had personally seen climate change impacts during their time in the park, and if so, what; whether and how they discuss climate change with visitors; and how they viewed the position and actions of the National Park Service and Yosemite's administration related to climate change. I obtained permission to record each interview and later transcribed these recordings. I used an inductive approach to analyze the transcripts in order to understand the themes that emerged. This analysis revealed a common use of both scientific evidence and personal testimony in the form of place-based anecdotes to support scientific claims about the nature of climate change.

Interpreters' Use of Scientific Argument

Yosemite interpreters employed both traditional forms of scientific claims as well as personal testimony to make arguments about climate change. I examine these traditional forms of evidence before turning to the use of anecdotes to create blended arguments using multiple forms of knowledge. Although many interpreters lack technical scientific training and none are full-time professional scientists, most of Yosemite's interpreters demonstrate what Kinsella (2004) called "a working vocabulary of scientific terms and concepts, and an overall understanding of how technical reasoning operates" (p. 92). Interpreters are sufficiently well-versed to give programs on (or at least discuss the basics of) a broad range of scientific topics, including geology, ecology, wildlife biology, and climate change, as they relate to the park. All the interpreters I interviewed gave scientific explanations for the phenomenon of climate change, and linked it to ecological explanations for observable changes to the park's resources. In this way, participants employed a form of scientific argument in which nonexperts use "scientific data

produced by credentialed scientists to support a claim" (Endres, 2009, p. 55). Such scientific arguments are used to assert that climate change is real, that its impacts are local as well as global, that its effects are already observable, and that it is anthropogenic.

Common examples of scientific data as the basis of argument included ecological explanations for observable environmental changes and decreasing snowpack percentages. Both of these represent a reliance on scientific data rather than direct observation, since participants had not carried out measurements or research themselves, and many of these phenomena are based on models of future climate change impacts rather than current ones. The most prevalent example of the use of expert produced data to support a scientific argument was an ecological explanation for the recent spike in tree mortality throughout Yosemite, which linked various elements of the ecosystem to shifts caused by climate change. For example, one participant said,

> We had very little to no snow that last few years, which affects everything in the ecosystem. So the forest is really stressed due to the lack of water. We had the huge die-off of ponderosa pines. The root cause of that is the drought, which is caused by climate change. And then we had bark beetles…taking advantage of the system and of their food source and that imbalance in the ecosystem.

Another described the process this way:

> What we're experiencing now is—with the lack of moisture with the drought situation, which can be attributed to climate change, um, and the trees not having the ability to exude sap and flush those insects out because they're stressed already—it's like the perfect storm. And then you have the insects not having cold enough winters to decimate a good portion of their population. You get three or four factors like that coming together, and we're seeing definitely, full-on, this is the evidence of climate change with ponderosa pines.

These explanations were common among participants and demonstrate a working knowledge of local ecology, conveyed as a scientific explanation for climate change impacts. Interpreters drew on their understanding of ecological linkages between species and drought, and connected this ecological knowledge to climate science. In doing so,

they relied on the cause-and-effect explanations offered by experts. While Yosemite's millions of dead trees are clearly visible, the linkages between drought, bark beetle infestation, and warming winter temperatures are not necessarily obvious on an experiential level; bark beetles are not visible in standing pines without special equipment, and lower levels of sap exuded by drought-stressed trees must be established through long-term measuring. These explanations for the ponderosa pine die-off are therefore examples of technical rather than local or experiential knowledge, as participants learned these explanations from experts rather than through direct experience.

Some, but not all, participants cited scientific articles or statistics learned from park scientists as the sources of their explanations. For example, one participant cited a statistic from the park's head forester, saying, "[He] gave me a quote that between the elevations of 3,000 and 4,500 feet, we're losing about 70% of our pines." Another cited "articles I've read" as the source of her information on the die-off. Other participants gave ecological explanations without citing scientific studies explicitly. However, they used scientific explanations from outside the realm of direct observation, demonstrating a reliance on data produced by professional scientists. This reveals participants' ability to interpret scientific data to produce a causal explanation.

Participants' citation of experts and use of technical reasoning are ways of making scientific arguments about the nature and effects of climate change. Participants could have proposed alternative explanations for these visible phenomena, such as natural, cyclical changes in forest composition or climate regime, but instead offered the scientific argument that climate change is anthropogenic and the cause of these observable changes to the forest. The invocation of scientific studies constitutes scientific

argument in that participants advocated for scientific explanations for the phenomena observed and drew upon scientific research on the anthropogenic nature of climate change, while simultaneously implicitly rejecting alternative explanations.

Many participants explicitly invoked scientific explanations, distancing themselves from explanations they considered to be "pseudoscience." For example, one participant said, "The scientists tie [climate change] to burning of fossil fuels, and that the National Park Service believes, we believe in what the scientists say, and to us there's no question about it." Another said, "Climate change is what's happening. It is the science." Another stated, "Our stance is based on science, and our stance is that humans are a contributor to climate change." Yet another said, "The scientific studies show that it is…human-induced, starting at the Industrial Revolution, and it's pretty irrefutable." By drawing on scientific studies, interpreters aligned themselves and the agency they represent with the scientific consensus regarding the anthropogenic nature of climate change.

Personal Narratives of Place

In addition to the invocation of scientific data and use of technical reasoning, participants also drew on their own experiences as evidence for the scientific claims they made about climate change, merging the personal with the technical. Employees' histories of living in or near Yosemite created narratives based on sense of place, in which participants told place-based stories to describe personal experiences of climate change in the park, anchored in direct encounters with shifting conditions. The foundation of these narratives is local knowledge, produced by a sense of place that comes only through the experience of inhabiting a particular landscape. Carbaugh and Cerulli (2013) stressed "the importance and exclusive role in actually being there in order

to understand a place, and to know how it has changed" (p. 13). By telling personal narratives of change, participants engaged in the eye-witnessing of climate change, but also used these narratives as evidence for the scientific arguments they made regarding the nature of climate change. Anecdotes served as evidence that climate change is already happening, and were sometimes also positioned as evidence for the anthropogenic nature of climate change.

Employees used personal accounts to demonstrate that climate change, in the words of one participant, "already has had an effect. We're already seeing the effects of climate change on Yosemite." Many of these narratives were anchored on particular objects that served as proof of their testimony. For example, several employees who worked and lived in tent cabins in the park's higher elevations described warming nighttime temperatures. Two illustrated their observations by saying that their water bottles used to freeze over at night and no longer do, while another said she used to sleep in two down sleeping bags to keep warm and now only needs one. Another employee from a lower elevation described decreased water levels in the river where he used to enjoy swimming, while another discussed the shorter ski seasons at the park's ski resort. Others offered observations about the disappearance of certain species, including pika, golden mantled squirrels, and evening grosbeaks, which they attributed to climate change. Tuan (2001) has noted, "Objects anchor time" in a given place (187), providing a sense of continuity and context for one's inhabitance of a particular location. The objects and entities invoked by employees, including water bottles, snow, animals, and many others, illustrated in very tangible ways the shifting conditions in Yosemite and served as markers of changes over time.

Not all narratives, however, included such tangible evidence of change. Many

employees, while explicitly invoking climate science as the explanation for observable changes to the local environment, also used ethos-driven reasoning to differentiate their narratives from scientific data by highlighting the personal, lived nature of their accounts. Many described “a feeling” that the region is getting warmer, that “winter seemed harder” years ago, and that it just “seems” drier. Participants used their identities as long-term residents of the park and surrounding region to establish their credibility as witnesses of climate-driven environmental changes. This reliance on personal experience aligns with the character or identity based nature of ethos driven arguments (Brinton, 1986; Oldenburg, 2015). In contrast to the expert-produced data cited implicitly and explicitly when participants made traditional scientific arguments, they often emphasized the anecdotal nature of the evidence they used when making blended arguments based on both local and technical knowledge. In this way, they drew attention to the lived experience of climate change rather than the purely scientific explanation. One participant called her observations “unscientific data” and said of her responses, “These are all, of course, my unscientific, extremely biased answers…” This participant noted that her data came from her perceptions of her surroundings rather than formal research. Many other participants drew on their “feelings” that the local environment had changed, noting that their evidence was experiential rather than the result of formal measurement. For example, one employee, describing her perception of warmer river temperatures, said, “I don't have any data to back that up…but that's another personal experience that I feel like I'm noticing--the water temperature's not as cold.” Another said, “I mean, I think, having lived here as long as I have, I do feel like, just from my own personal observations, winters are warmer and drier…it just feels like it's warmer and drier.” Yet another said, “I haven't documented this. It's just a feeling, right? Like a gut feeling.”

Many noted that their observations were "just anecdotal," "a feeling," and "not very tangible." By tempering their narratives with these phrases, participants exempted their observations from the burden of "hard data" and systematic study, while maintaining the argumentative force of their accounts through the validity of personal experience. Instead of citing statistics and studies, in some cases, participants drew on their own ethos as long-term residents who were uniquely qualified to offer observations of change due to their intimate familiarity with the landscape. These narratives are important examples of climate change testimony, in which lived experience can be valued as expertise and the "vagaries" of climate change can be defined locally and personally (Anderson, 2012, p. 39).

Personal Narratives as Evidence for Scientific Arguments

Although many participants understood their anecdotes to be less verifiable than hard data and numerical records, interpreters did not view their personal experiences as less compelling than scientific research. Rather, they understood their narratives to be both complimentary to and more accessible than formal scientific data. One participant, for example, said that long-term employees

> really can talk to things that maybe haven't shown up in the reports yet, haven't, you know, been…peer reviewed and published, but that everyone who's been here for really long are aware of. Those kinds of things I think are really important.

She stressed the importance of these first-hand accounts, saying,

> Park hoppers, the people who don't stay in one park longer than a year or two, I don't think have the same ability to carry those stories. They have to tell other people's stories, and I think it is stronger when you're telling your own stories.

Many interpreters used personal narratives rooted in long-term familiarity with the park as evidence for their scientific arguments about the already-observable and anthropogenic

nature of climate change, which they presented to the public, to be considered by visitors in conjunction with and as further proof of scientific explanations of climate change.

Some participants noted that personal, place-based narratives are effective as a complimentary form of evidence for data-driven scientific research. One interpreter noted that her narratives of climate change experience are "backed up by…data," all of which can be presented to visitors during discussions of climate change. Another participant believed personal stories carry more weight with visitors, saying, "If I talk about the changes that *I've* seen, those are real things." Another said, "I think people do like the personal examples better." Yet another said his personal observations of changing local conditions are "resonating with them [visitors]" because "it's getting harder and harder to deny climate change" on an experiential level. These participants address their narratives to a public they perceive as ambivalent about or deniers of climate change, and use these anecdotes as arguments that climate change not only exists, but is locally-felt in Yosemite.

Many interpreters drew on this personal, long-term experience in the park as arguments that climate change is already happening. For example, one said of her interactions with visitors, "I do use personal observations all the time...I do talk about the tree death…and the fact that I don't need two down sleeping bags at night anymore…and so I do continuously use those examples of climate change." Another participant emphasized her long history in the park along with specific anecdotes that illustrate the dramatic climatic shifts she has witnessed over her lifetime:

> Sometimes I mention the water bottle example [to visitors]. I've been coming to Yosemite since I was 2 weeks old, so I have a lot of history here myself, and I say there used to be more snow when I was a kid. And in 1983, we had a big El Niño year with 50 feet of snow, and I used to work up here and my water bottle would freeze, so I mention those examples.

Another, describing high rates of tree mortality in the area, said, "…It's affecting a lot of areas down in Sierra National Forest [just outside Yosemite], that I'm well acquainted with, that I've grown up around." These personal, place-based narratives are examples of stories used as arguments for the reality of locally felt climate change, rooted in local knowledge of past and present conditions. These examples not only demonstrate the practice of bearing witness to climate change (that is, reflexively connecting observations of change to both personal and larger meanings of climate change), but also serve to convince others that climate change is visible to those with a history in the area. This is a particularly important function given the lack of long-term experience among visitors; the average length of overnight stays in Yosemite is 57 hours, and over half of visitors annually are entering the park for the first time (Blotkamp et al., 2009). One employee noted that such visitors are incapable of seeing climate change impacts themselves, saying,

> I think one of my biggest frustrations is that a lot of people come to Yosemite and they come here once, to our national parks where you can really see climate change happening. And the problem is that people, because they're not here multiple times, whatever their experience is in the one time that they come to the national park, that is the way that that park is, in their heads…and it's going to start to redefine normal.

The narratives of long-term employees, by contrast, provide important context for visitors who lack a sense of past conditions and the ways in which current conditions may relate to climate change.

In addition to using place-based narratives as evidence that climate change is already happening, some participants also linked their narratives with scientific data on the causes of climate change, using personal experience as evidence for anthropogenic climate change. Although using anecdotes in this way is technically an example of a non

sequitur due to the impossibility of directly observing anthropogenesis, it demonstrates an attempt at narrative coherence and perhaps a strategic structuring of arguments to align personal experience with scientific credibility. Although participants had not personally carried out the studies they cited, by situating personal anecdotes in close proximity to these studies, it created a sense that lived experience somehow confirms the findings of scientific research, although this is impossible to establish with certainty. For example, one participant said, "This is what I've seen in my lifetime here. And the scientific studies show that it [climate change] is…human induced." By using her own experience in conjunction with a scientific explanation for the anthropogenesis of climate change, this interpreter connected her personal narrative to scientific studies that demonstrate the causes of the changes she has witnessed. Another participant described one of his regular winter-time programs in which he addresses climate change, both natural and anthropogenic:

> And I gently talk about how I don't see the snowpack in the Valley in the wintertime that I used to see…The question is, is human activity accelerating the rate of climate change? And I kind of just make a statement: That's the controversy. Yes, climate does always shift, but you know, the big controversy is, are humans affecting it? And then I talk about how my personal experience has been that it *is* changing fairly fast, and the scientists tie it to burning of fossil fuels…and just kind of leave it at that.

This participant used his personal experience to confirm the findings of the "scientists" regarding the anthropogenesis of climate change. The linking of personal observations with scientific studies is an interesting example of a hybrid argument that blends local and scientific knowledge. Participants were capable of offering testimony of rapid changes to the environment, an example of local knowledge founded on sense of place. However, arguments regarding the root causes of those changes must be drawn from scientific research that falls outside the realm of direct experience, since the

anthropogenic nature of climate change is not accessible to personal observation. By linking personal narratives with scientific data that are only partially related, however, interpreters made their personal observations seem like evidence for the anthropogenesis of climate change by virtue of the sheer proximity of the narrative to the scientific argument. Technically, this is an example of a non sequitur, because conclusions about the anthropogenic causes of climate change do not follow from the personal observations given about the effects of climate change. However, by placing personal narrative in close proximity to scientific arguments, interpreters positioned themselves as local experts whose lived experiences qualify them to make claims both about the local effects of climate change as well as its causes.

These uses of anecdotes represent an attempt at narrative rationality, whereby a story may be understood as rational if it "coheres or 'hangs together'" and demonstrates a reasonable "sequence of thought" (Fisher, 1984, p. 349). The move from observations of the effects of climate change to scientific explanations for the causes of those changes is a rational sequence of thought, despite the fact that such observations cannot actually stand as evidence for the conclusions participants make. Instead, interpreters used narrative structure to describe a sequence of events they had experienced, and ascribe to those events a particular scientific meaning and explanation.

Implications

This chapter has explored the ways in which technically competent nonscientists blend local and scientific knowledge to make hybrid arguments about the nature of climate change. This analysis has implications both for public understanding of science and climate change communication. First, it increases our understanding of the ways that

personal narratives can be employed to make scientific arguments, challenging the discreteness of rhetorical spheres. It also seeks to expand the critical focus of PUS to include the use of scientific arguments by nonscientists in contexts other than public participation in science policy and decision-making. Finally, it sheds further light on the relationship between personal narrative, sense of place, and local knowledge in persuasive climate change communication.

This chapter turns critical attention to the ways in which nonexperts understand and make scientific arguments about climate change using multiple forms of knowledge and evidence. Endres (2009) has argued that PUS studies "will benefit from a shift in focus to an examination of scientific arguments made by non-credentialed scientists" (p. 68). This chapter contributes to this development, focusing on the hybrid arguments of Yosemite's interpreters as an important case study of the ways that nonscientists combine scientific data with personal, place-based narratives to make scientific claims.

Furthermore, this chapter demonstrates that personal narratives can be used as evidence in scientific arguments, highlighting the overlap of the private and technical spheres. Endres (2012), Jackson, Jr. (2006), Keränen (2005), Lahsen (2005), Macfarlane (2003), Rowland (1986), Shackley and Wynne (1995), Stephens, Wilson, and Peterson (2008), and others have argued that the boundaries between the private, public, and technical spheres are overlapping and porous. However, while many studies have demonstrated the ways in which the public and technical overlap, relatively few address the interaction of the private and the technical. Technically competent nonscientists such as National Park Service interpreters embody this overlap, since many lack formal technical training but are positioned as authorities on the park's science. For this reason, they are particularly well-situated to provide both scientific data and narratives of lived

experience, which complement one another in the development of scientific arguments about climate change. Although none of the participants in this study were professional climate scientists, they were all familiar with and capable of invoking the basic scientific concepts at play in the phenomenon of climate change. As Kinsella (2004) has argued, nonscientists "need not acquire the same depth of technical knowledge as specialists" (p. 92), but some level of technical competence is advantageous for participation in scientific public discourse. Participants' credibility in making scientific arguments is enhanced by their personal narratives of place, by which their lived experiences concretize the abstractions of climate science. In this way, the blending of local and scientific knowledge exemplifies the dual importance of technical competency contextualized and made meaningful by local expertise, grounded in sense of place developed over time.

In addition to demonstrating the ways personal narratives can be used to make technical arguments, this chapter begins to expand the focus of PUS beyond the realm of public participation in science policy decisions. Public understanding of science is broadly defined by Condit et al. (2001) as "studies exploring science–public interactions" (p. 387); however, PUS has traditionally focused on the ways in which scientists and politicians have attempted to educate and engage the public in science and science policy decisions (Endres, 2009). In addition to the need to expand PUS to include the scientific rhetoric of nonprofessional scientists, PUS will benefit from greater attention to the role of scientific argument outside the realm of public participation in environmental decision-making to include the study of scientific arguments between and among members of nonexpert publics. Delicath (2004) has called for a reenvisioning of public participation to include "the skills, knowledges, and emotions involved in citizen advocacy outside of specific forums of government" (p. 255). This chapter begins to

answer this call by exploring the ways that nonexperts use hybrid arguments of local and scientific knowledge to advocate for scientific explanations of climate change, outside the realm of environmental decision-making. Discussions of climate change increasingly happen between fellow laypersons, particularly online (Gavin & Marshall, 2011; Hestres, 2014). Social media platforms characterized by an "architecture of participation" (O'Reilly, 2004) facilitate public scientific arguments by nonexperts and challenge long-standing technocratic models of science communication. Although this chapter addresses arguments by nonexperts in face-to-face rather than social media settings, the insights gained by this analysis can also shed light on the expanding role of scientific argument by nonexperts on and offline. Specifically, it highlights the persuasive potential of place-based narratives. Given the controversial nature of climate change (Banning, 2009; Ceccarelli, 2011), as well as the urgency of the problem (Cox, 2007), it is important to turn critical attention to climate change communication between fellow members of publics in order to understand whether and how nonscientists can persuade one another with scientific and narrative arguments.

The use of narrative as evidence in scientific arguments fits with Lucaites and Condit's (1985) conception of dialectic narratives, which seek to establish the truth of events and phenomena and "require empirical verifiability" (p. 93). In the case of climate change, however, empirical scientific data have thus far proven to be insufficient to catalyze meaningful policy or widespread social action (Hamblyn, 2009), demonstrating that the reverse is also true: empirical data need meaningful narrative. This chapter examines the relationship between local knowledge, produced by sense of place, and the narratives of lived climate change effects that flow from it. Long-term relationships with Yosemite's environment endow interpreters with a sense of change over time in a setting

with which they are intimately familiar. By providing an in-depth look at anecdotes of lived experiences of climate change, this chapter adds to the growing body of literature that attends to the necessity of first-person testimony that makes real the complexity and abstraction of climate change (Alexander et al., 2011; Anderson, 2012; Bravo, 2009; Daniels & Endfield, 2009; Hamblyn, 2009; Moser, 2007; Roeser, 2012; Schroth et al., 2014; Schweizer et al., 2013). Interpreters in Yosemite, who are in a position to engage visitors on scientific topics, do not hesitate to use personal narratives alongside and as evidence for scientific claims about climate change. In this way, they begin to create what Hamblyn (2009) calls "a collective narrative" (p. 232) of lived climate change impacts. One participant recognized the persuasive potential of this collective narrative, describing what she perceived to be its effects on climate change deniers:

> All you can do is be one presentation of climate change that they choose not to accept. And then they're gonna get another one. And another one. And another one. And another one, through their lives, until they finally accept it. So I know I'm not going to change their mind in that moment. My job, I feel, is to just be another presentation of the facts. Whether or not they want to believe them is up to them. But now they have those facts as we see them, and they can carry that with them as they go to wherever.

Multiple presentations of the "facts as we see them," including anecdotes that illustrate those facts, constitute a collective narrative that may have the power to sway those who doubt the reality of climate change. However, more research is needed in order to understand whether and to what extent these narratives are actually persuasive to visitors. Studying the reception of narrative evidence in scientific arguments is an important direction for future research that will shed additional light on the potential of nonprofessional scientists to engage with and persuade fellow laypersons regarding scientific topics. This is particularly vital with respect to climate change, a pressing yet controversial issue whose widespread effects might translate into easily accessible

material for narrative arguments. While some research exists on the presence of personal narratives in climate change educational materials (for example, Spoel et al., 2008) more is needed on the effects of anecdotes when they are used as evidence in a scientific argument put forth by an individual rhetor.

Conclusion

Climate change is an urgent problem whose representational challenges add to its complexity. For this reason, it is imperative to examine testimony of lived climate change experience, from individuals of all levels of technical competency, in order to better understand how climate change can be concretized and localized. Personal anecdotes function as an implicit argument about the reality of local climate change, but they can also be used as evidence in explicit arguments about the severity and cause of the phenomenon. By turning critical attention to the narratively driven climate change arguments of nonscientists, this chapter begins to demonstrate the productivity of expanding the focus of PUS to include the ways that publics integrate their lived experiences with larger scientific concepts and use these experiences as arguments aimed at fellow members of publics outside the context of public participation in science policy decisions. Furthermore, examining the blending of local and scientific knowledge challenges the boundaries between the private, public, and technical spheres, illustrating that personal narratives can serve as evidence in technical arguments. The widespread effects of climate change are grounds for further study of the ways in which individuals with all levels of expertise use every form of evidence at their disposal, and in a variety of forums, to testify to the scientific phenomenon of climate change as it unfolds in their own local environments.

CHAPTER III

"RAPID AND DRAMATIC CHANGE": YOSEMITE'S INSTITUTIONAL VOICE AND THE ARTICULATION OF MULTIPLE ENVIRONMENTAL DISCOURSES

2016 was the busiest year Yosemite National Park has ever seen, with a total of over 5 million visitors (National Park Service, 2017). However, most of those visitors did not interact with National Park Service employees except at fee collection stations. Fewer than half of park visitors obtain information about the park from a park employee, while only about 10% attend a ranger-led walk or talk (Blotkamp et al., 2009).[9] By contrast, texts produced by Yosemite National Park are a source of information accessed by millions. In particular, the park's website is a significant site of education and information for current and potential park visitors, while other texts physically located in the park are utilized far more frequently than ranger-provided services. In 2016, Yosemite's website received over 2 million unique views (M. Ortiz, personal communication, November 14, 2016). Any interested member of the public can access Yosemite's website to obtain information about park-related science, infrastructure, and tips for visiting. Other texts put out by the park include a newsprint guide, which is read

[9] 2009 is the most recent year for which statistics are available. These percentages have likely decreased, as visitation has increased while staffing levels and program offerings have decreased.

by over 70% of visitors; trailside and outdoor exhibits, utilized by 31 and 27% of visitors, respectively; and indoor, museum-style exhibits, used by 23% of visitors (Blotkamp et al., 2009).

Yosemite's texts, with their wide reach, are an important site for the study of climate change communication and engagement. The park's cultivation of a particular voice on climate change is crucial for addressing this delicate issue and diverse audience. Examining the climate change-related texts produced by Yosemite provides a valuable case study on the ways in which the voices of public institutions navigate the complex waters of competing environmental discourses in order to communicate about climate change.

In this chapter, I offer an analysis of Yosemite's institutional voice by studying the climate change-related texts produced by the park, including written text on the park's website, interpretive texts physically located in Yosemite, and online videos featuring park employees and residents. Certainly, other elements contribute to Yosemite's voice, particularly employees who speak for the park during interactions with visitors (as discussed in Chapter II). However, in this chapter, I examine the texts that fall outside the realm of interpersonal interaction in order to focus on Yosemite's more systematically curated articulations of climate change. The texts examined in this chapter are static, rather than dynamic and flexible like the climate change messages produced in real time by employees interacting with visitors. Although the online videos examined here feature park employees and residents speaking from a first-person perspective, they are also selected, edited, and, to a certain extent, scripted by park administrators. For these reasons, I argue that the texts analyzed in this chapter constitute a more regulated form of institutional voice than that created by employees who speak extemporaneously for the

park when interacting with visitors. It is important to note, however, that the climate change-related texts addressed in this chapter represent a small percentage of the total number of texts produced by the park. For example, out of 186 wayside interpretive signs found throughout the park on trails and roadsides, only 13 reference climate change. The relative dearth of climate change-related material among the body of park-produced texts creates the impression that climate change is of minor significance, a message that contradicts the stance of the National Park Service that climate change is *"*the greatest threat to the integrity of our national parks that we have ever experienced" (National Park Service, 2010). However, assembling and analyzing the texts that do address climate change facilitates a greater understanding of the rhetorical effects of this contradiction alongside other park-produced messages about climate change.

The voices contained in park-produced texts combine to create a polyphonic institutional voice that is constituted by multiple environmental discourses at once. These discourses include scientific rationalism conveyed via online written text, a precautionary discourse conveyed by in-park texts, and an apocalyptic discourse conveyed by the individual, embodied voices of employees and residents featured in online videos. These embodied, individual voices engage in apocalyptic rhetoric through the use of personal narrative and pathos. The scientific voices of disembodied written text dominate the embodied voices of apocalypse though a website structure that privileges written text and an overall institutional voice that privileges the rational and scientific. Taken together, Yosemite's polyphonic institutional voice brings together these discourses to articulate the complexities of climate change using a voice of tempered scientific rationalism.

Since various institutions and organizations, including government agencies and nonprofits, are frequently the sources of climate change messages for publics,

institutional voice, the mechanism by which organizations articulate the complexities of climate change, is a particularly rich area of study (Leiserowitz et al., 2010; Moser, 2010). The National Park Service is an especially interesting example of institutional voice because it must navigate and articulate a complex set of tensions. It is fundamentally both political and scientific in nature; it is a government agency that is ultimately beholden to the policies of the administration that oversees it, and its mission to preserve natural resources is reliant on principles of the biological and ecological sciences. The ways in which such an institution navigates shifting climate change policy *and* climate science is an important question that can shed light on the rhetorical strategies used to address the relationship between uncertainty and controversy that undergirds climate change communication. The role of institutional voice is of particular interest, since it is this voice that is encountered by publics, and this voice must convey the institution's relationship to climate change and climate science through its invocation of particular environmental discourses. I begin with an overview of the literature on voice, discourses of scientific rationalism, precaution, and environmental apocalypse. Next, I describe the methods used to analyze the texts examined in this chapter. I then offer an analysis of Yosemite's online written texts, characterized by a voice of scientific rationalism; interpretive and educational texts physically located in the park, which rely on arguments of irreparability to cultivate a voice of precaution; and videos from Yosemite's website, which feature the embodied voices of individual employees and park residents who use personal narratives to articulate an apocalyptic rhetoric. The chapter concludes with a discussion of the implications of this analysis for theories of voice and climate change communication. This chapter sheds light on the rhetorical mechanisms of the discourses of scientific rationalism, precaution, and apocalypse, contributing further

insights on the uses and devices of polysemy, constructions of the irreparable, and articulations of apocalypse as both a present and future phenomenon.

Institutional Voice

Research on climate change communication constitutes an entire subsection of the environmental communication literature, yet so far little, if any, has examined the role of voice in the climate change messaging of public institutions.[10] In the environmental communication literature, voice is used primarily as a metaphor for agency and efficacy in conveying a message (Belanger, 2014; Bsumek, Schneider, Schwarze, & Peeples, 2014; Prody & Inabinet, 2014; Senecah, 2004). More broadly, voice is used to describe the physiological mechanism of utterance (Dolar, 2006; Hymes, 2003); the "instrument, the vehicle, and the medium" for constructing and articulating meaning (Dolar, 2006, p. 4); "a mechanism for expressing one's thoughts through sound and action" (Depoe & Peeples, 2014, p. 3); and the means of expressing "distinctive perspectives on the world" (Couldry, 2010, p. 1). Voice is ascribed to communities as well as individuals (Bucholtz, 2011; Hymes, 2003) and characterizes personally and regionally unique modes of expression and distinct ways of putting words together orally and in writing (Hymes, 2003).

Watts (2001) has articulated the "tension" between the notion of voice as the property of the speaking self and as a metaphor for the "idioms, vocabularies, and sets of cultural meanings" (p. 192). He attempted to bridge these meanings by defining voice as "a

[10] However, research has been done more broadly on climate change communication from organizations, much of it with a focus on practical application. A few examples include Han & Stenhouse, 2015; Lejano, Tavares-Reager, & Berkes, 2013; McKibbin & Wilcoxen, 2002; Nerlich, Koteyko, & Brown, 2010.

relational phenomenon occurring in discourse" (p. 180), drawing attention to the communal ways of speaking that mark a rhetor's speech and written texts, which will reflect the social standing of the speaker and his or her relative efficacy in conveying that message. This notion of voice, as both distinctive ways of putting words together in speech and writing and as a relational phenomenon, has yet to be meaningfully integrated into the climate change communication literature, particularly in regard to the organizations whose voices articulate the complexities of climate change to the public. This is a significant gap in the literature given that government and nonprofit institutions are an important source of information for the public about climate change (Leiserowitz et al., 2010). Because climate change as a subject of public engagement is the product of climate science, the communal nature of voice is particularly significant. Yosemite's institutional voice is communal both in the sense that multiple individuals contribute to it and in the sense that it is part of the larger scientific community, which also has a distinct voice expressed in scientific publications and broader scientific discourses (Halloran, 1984).

The role of multiple individual rhetors in creating the voice of an institution has been largely overlooked. Jacobs' (1999) study of the role of voice in press releases is one of the few that offers a definition of institutional voice or explores the relationship between the individual and the collective in the formation of voice within organizations. He defined institutional voice as the process by which "the individual writer's personal identity is deleted, or at least disguised, in favour of that of the organization" (p. 86). However, this definition does not account for the multiple sources that can contribute to an organization's voice and combine to create a distinct way of putting words together that differs from any single individual's voice. I focus on the ways in which a multiplicity

of voices, many of which are unattributed to any particular author, come together to create a distinct institutional voice of polyphony for Yosemite National Park.

An organization's voice might be said to be polyphonic if it is composed of multiple smaller voices. The concept of polyphony was originally articulated by Bakhtin (1973) as a "plurality of independent and unmerged voices and consciousnesses…each with equal rights to its own world [that] combine, but do not merge, into the unity of an event" (p. 4). Polyphony has subsequently been applied to organizational studies as a metaphor for the diverse perspectives and their articulations that constitute the complex nature of "organizations as discursive spaces" (Belova, King, & Sliwa, 2008, p. 495). Yosemite's institutional voice is polyphonic in that it relies both on 1) a dominant, disembodied voice conveyed through written text on its website, which is not attributed to any one author; and 2) on embodied individuals who are configured to represent the National Park Service through their iconic uniforms and who appear in videos on the park's website. These various subvoices all speak for the park and together make up the polyphonic institutional voice of Yosemite. This polyphony facilitates the expression of multiple environmental discourses at once, allowing the park to position itself as part of the larger scientific community, in part by relying on a text-based voice of scientific rationalism.

Multiple Environmental Discourses

Scientific rationalism is one of many competing environmental discourses used to communicate about climate change, and one of three that characterize the voices of Yosemite's texts. According to Johnson (2009), "there is no longer a single environmental rhetoric that can be categorized or canonized" (p. 31); rather, environmental texts come to be persuasive through the interaction of multiple

environmental discourses. She went on to argue that, because of the complex relationship between environmental discourses, climate change communicators such as Al Gore have been prone to vacillating between contrasting discourses, fluctuating between apocalyptic and scientific rhetoric, creating texts that are best described as "*tempered* apocalyptic" (p. 31, emphasis in the original). Yosemite's climate change communication reveals a similar, though inverse, interplay between rhetorics of scientific rationalism, precaution, and apocalyptic. The result is a complex institutional voice that relies primarily on disembodied and depersonalized text-based messages that avoid the apocalyptic in favor of the rational and the precautionary; any climate change-related message that does not conform to the standards of scientific rationalism is outsourced to a set of secondary, individual voices that at times engage in personal narrative and apocalyptic rhetoric via online video. In this way, Yosemite's climate change communication is constituted by an amalgamation of multiple environmental discourses; the park navigates the tensions in these discourses by assigning them to various subvoices that together compose a polyphonic institutional voice characterized primarily by tempered scientific rationalism. Below, I provide an overview of the three environmental discourses that characterize Yosemite's institutional voice, beginning with scientific rationalism before examining precautionary and apocalyptic rhetorics.

Scientific rationalism is a characteristic of the scientific community, which is marked by a particular set of values (Longino, 1990). These values were most notably set forth by Merton (1938), and include disinterestedness, universalism, communality, and skepticism. Together, these values amount to "*emotional neutrality* towards ideas and actions" as "scientifically virtuous" (Prelli, 1997, p. 100, emphasis in the original). Indeed, Barber (1953) held emotional neutrality to be normative in the scientific

community, arguing that "the value scientists set upon emotional neutrality" is "an instrumental condition for the achievement of rationality" (p. 88). Although he acknowledged that "strong emotions" are not "entirely absent in relations among scientists themselves," he contended that emotional neutrality is paramount to "the evaluation of the validity of scientific investigation" (pp. 88-89). Whether or not the emotionally neutral ideal is achieved, as a value it is reflected in scientific writing, which propagates "a particular image of the scientist speaking, within a broader set of more vague and general norms that apply to all scientific discourse," particularly scientific journal articles (Halloran, 1984, p. 75). Yosemite's disembodied, text-based voices fit within this scientific discursive community, conveying emotional neutrality in regard to climate change that is consistent with scientific rationalism.

Distinct from, but not incompatible with scientific rationalism, is the environmental discourse of precaution. This discourse is rooted in the precautionary principle, now commonly part of public discussions surrounding science policy decisions (Moreno, Todt, & Lujan, 2010). It holds that actions should be avoided if they may have negative consequences for the environment, even if those consequences are not precisely known. Additionally, anticipatory action should be taken to protect human health and the environment in the case of scientific or technological developments that may pose an unknown risk (Moreno et al., 2010). The "core meaning" of the precautionary principle, according to Whiteside (2006), is the avoidance of "new risks" that "are large scale and develop slowly, often with irreversible consequences" to the environment and human health (p. 30). Precautionary discourse, then, prizes the conservation of the more "natural" status quo (Depew, 2001) and advocates restraint (Avon & Hirokawa, 2001, p. 153). Rather than seeking to mitigate potential environmental damage, the precautionary

principle prioritizes the prevention of environmental damage in the first place. Patrick (2007) argued that the precautionary framework is characterized by

> (1) employment of a long-term perspective; (2) adoption of a holistic view of ecosystems; (3) empowerment of the public by communicating information and resources; (4) recognition of the potential for a diminished future; (5) acknowledgement of scientific uncertainty. (p. 146)

Based on these conceptions of the precautionary principle and its rhetorical uses, I define the rhetoric of precaution as an environmental discourse that emphasizes uncertainty, interconnections and whole ecosystems, privileging of the "natural" state prior to human-induced harm, and preservation of an undiminished future state. Precautionary rhetoric is compatible with a rational scientific discourse, provided that it is invoked in an emotionally neutral way.

These characteristics, particularly the use of long-term perspective and emphasis on a potentially diminished future, align strongly with conceptions of the irreparable, which, I argue, is central to a rhetoric of precaution. Som, Hilty, and Köhler (2009) emphasized that "irreversibility can be used as a criterion essential to operationalizing the (precautionary principle)" (p. 500). The notion of irreversibility is used rhetorically to construct loci of the irreparable, where decisions, once made, "cannot be repeated" or reversed (Perelman & Olbrechts-Tyteca, 1969, p. 92). According to Cox (1982), the irreparable is invoked when a rhetor "[c]laims that a decision cannot be repeated or that its consequences may cause an irreplaceable loss" (p. 227). In order to be irreparable, an "object or act" must be unique—"distinct, original, rare, or exceptional" (p. 229), precarious or threatened, and bound by time, or requiring a timely action in order to be saved. Because it emphasizes what might be permanently lost if the appropriate action is not taken, precautionary rhetoric can only function in conjunction with notions of the

irreparable.

Precautionary rhetoric represents a midpoint between scientific rationalism and discourses that are incompatible with scientific rationalism, particularly apocalyptic rhetoric. Apocalyptic rhetoric is constituted by "imminent demise" (Peeples et al., 2014, p. 229) or language that "gestures in some way toward future disaster" (Johnson, 2009, p. 33), and is a discourse that has commonly been associated with climate change. According to Patrick (2007), the precautionary framework often overlaps with apocalyptic rhetoric. In these cases, "[n]arratives that employ precautionary strategies, including apocalyptic tropes, forecast environmental concerns and problems as worst-case scenarios that deserve attention" (p. 151). She argued that this apocalyptic strategy is compatible with the scientific ethos and has been used by a number of scientists, notably in Rachel Carson's *Silent Spring* (1962). However, scientific rationalism has traditionally been seen as incompatible with apocalyptic rhetoric. Most scholars who explore invocations of the precautionary principle emphasize its use as a rational or "common sense" scientific approach (Avon & Hirokawa, 2001; Depew, 2001; Ploeger, 2001; Welsh & Ervin, 2006; Woods, 2005), rejecting the use of apocalyptic tales within a rational precautionary discourse. I argue that precautionary rhetoric stands as its own environmental discourse, but can also be used in conjunction with both rational scientific and apocalyptic rhetorics.

Any strident environmental message could be accused of being "apocalyptic" (Foust & Murphy, 2009; Killingsworth & Palmer, 1995; Johnson, 2009; Peeples et al., 2014) and said to incite "hysteria" and perpetuate "doom and gloom" impressions (Killingsworth & Palmer, 1992). For this reason, there are risks in employing an apocalyptic approach when communicating about a scientific topic such as climate

change. According to Killingsworth and Palmer (1992), "The rhetorical danger of wolf-crying…cannot be overemphasized. To make a wrong prediction is to label oneself as a doom prophet and to cast doubts on one's authority as a scientific advisor" (p. 292). Therefore, institutions like Yosemite must navigate the complex relationship between scientific, precautionary, and apocalyptic discourses when communicating about climate change in order not to cast doubt on their status within the scientific community. By assigning these distinct rhetorics to different subvoices, the park's overall institutional voice encompasses all three, but privileges the rational scientific.

Method

Yosemite's text-based climate change messages are spread across multiple interpretive signs, displays, and literature throughout the park and multiple pages of the park's website. In order to understand how these fragments work together to create climate change messaging in the institutional voice of the park, I gathered photographs of every interpretive sign and display currently in Yosemite, including those in visitor centers and along trails and roads.[11] I then transcribed the climate change-related signs and displays in order to analyze these messages. I also analyzed the nine editions of the *Yosemite Guide* that were put out between December 2015 and December 2016, the most recent year of guides at the time of writing. This informational newspaper is handed to visitors at every entrance gate, and contains information on trip planning, interpretive programs, and articles on park resources. These signs, displays, and *Guides* represent all of the written climate change information produced in Yosemite that visitors can

[11] I collected these photos between June and September, 2016. Although signage is relatively permanent, it is occasionally changed.

encounter during their time in the park. Together, these in-park texts rely on a rhetoric of precaution that is compatible with the scientific rationalism conveyed in online written text.

Because at least half of Yosemite's visitors (Blotkamp et al., 2009), as well as millions of past and potential visitors, gather information from the park's website, Yosemite's online communication is also an important site for the study of the park's articulation of climate change. Rather than dedicating a single page to the science of climate change and its ecological impacts, the park has woven climate change information into its other science education pages. While there is no page devoted solely to climate change, topical pages contain fragments of climate change-related information. For example, on the wildlife page, users will find a small blurb that addresses the ways that climate change is expected to impact some of the park's threatened species. In addition to these text-based fragments, visitors to the park's website will also find a page entitled "Photos and Multimedia." Under this tab are a variety of videos, arranged chronologically, each devoted to a particular topic of interest, ranging from giant sequoias to granite. A number of these videos, particularly those focused on snow, glaciers, and hydrology, feature park employees and residents discussing climate change and the ways it impacts the resources featured in that particular video. I searched each page of Yosemite's website for climate change information and viewed all the videos that were likely to reference climate change. I then transcribed all climate change-related video clips and analyzed them, along with all the written text fragments that addressed climate change. In the analysis that follows, I will first examine the online written text, then the texts physically located in the park, and finally, the online videos featuring park employees and residents.

Online Written Text: The Disembodied, Rational Voice of Science

Although polyphonic, Yosemite's online voice is dominated by the disembodied, rationally scientific voice conveyed through written text on the park's website. This voice, which is not attributed to any single author, ostensibly serves as *the* voice of the organization, as it is positioned to speak for the depersonalized, monolithic institution. This polysemic set of texts is characterized by ambiguity, the enthymeme, and the subjunctive mood to create a cautious, technical tone in the park's articulation of climate change, consistent with a rational scientific ethos.

Polysemy

Polysemic texts employ wording that has the potential to evoke simultaneous and incompatible meanings, which, according to Ceccarelli (1998), "result(s) in two or more otherwise conflicting groups of readers converging in praise of a text" (p. 404). In the case of Yosemite's climate change messages, the park maintains a rational scientific voice through emotionally neutral language with regard to the causes of climate change, thereby refraining from engaging in the "debate" surrounding climate change and effectively avoiding alienating website users who might be climate change deniers. In this way, it can succeed with both climate change skeptics and those who accept the scientific consensus behind anthropogenic climate change. It tends to refrain from attributing the cause of climate change to any one source. For example, on a website page about wildland fire, the written text reads, "Due to vegetation type and build up, changing weather patterns, and increasing development, most residents of the Sierra Nevada foothills will experience a wildfire near their home during their lifetime" ("Prepare at Home," Yosemite National Park, 2016, paragraph 1). In this passage, climate change is

coded as "changing weather patterns," and is lumped in with a variety of other forces of change, both human-caused and nonhuman-caused, that are linked to increased fire danger in the residential regions at the wildland-urban interface. The paragraph is polysemic because it allows nature to be a possible agent in forest destruction. Any website user who does not believe in anthropogenic climate change is likely to read this reference to "changing weather patterns" as a natural, nonhuman phenomenon similar to "vegetation type and build up." By contrast, any user who is convinced that human activity is the source of climate change is likely to read "changing weather patterns" as a reference to anthropogenic climate change, which can be understood, along with "increasing development," as the result of human actions.

There are many references to climate change in the written text on the park's website, but only one passage deviates from ambiguity regarding the cause of climate change, explicitly addressing anthropogenesis. This passage is found on a page devoted to glaciers, a subpage of the geology section. It reads,

> Glaciers are sensitive indicators of climatic changes because their health depends on winter precipitation and summer temperatures…Although glaciers have come and gone from Yosemite many times in the past, scientists agree that the current melting is primarily due to warmer temperatures caused by human activities. ("Glaciers," Yosemite National Park, 2016, paragraph 3)

Here, the park invokes scientific authority to bolster its claim that climate change is anthropogenic, but maintains some level of ambiguity regarding the identity of the scientists in question. The reader cannot be sure who these "scientists" are. Perhaps they work for the National Park Service, but perhaps not. By employing the ambiguous and general "scientist" to back up the claim that climate change is "caused by human activities," the park effectively abdicates responsibility for that claim. At the same time, the use of the phrase "human activities" to describe the source of warmer temperatures is

not specific. Indeed, it is itself sufficiently ambiguous to encourage polysemy. This section of the website fails to specify that the primary human activity that contributes to climate change is the burning of fossil fuels (IPCC, 2014); "human activities" might mean *anything*, and the phrase is broad enough to allow readers to attribute responsibility to any activity or entity that might fit with their beliefs, whether or not they are scientifically sound.

Given the scientific consensus that climate change is indeed anthropocentric and is primarily caused by the burning of fossil fuels, Yosemite's website might easily take a firmer stance on the cause of the phenomenon and still maintain its scientific ethos by positioning itself within the larger scientific community. However, the lack of clear language regarding the causes of climate change might also be read as an attempt to foster a rational, scientific voice, for two reasons. First, many scientists and scientific institutions "assume that they can safely ignore claims about science that remain unpublished in scientific journals" (Ceccarelli, 2011, p. 213), believing that the best way to combat manufactured controversies is to refuse to engage with them and thereby legitimize them. The park's online written text can appeal simultaneously not only to members of the scientific community who hold this view, but also to members of the public who resist scientific understandings of climate change. Second, despite scientific consensus, approximately 30% of Americans remain unconvinced that climate science is based on solid evidence (University of Michigan Center for Local, State, and Urban Policy, 2015). By refraining from taking a firm stance on the causes of climate change, Yosemite remains outside the perceived controversy of climate change, maintaining an appearance of rationality and dispassion even to those website users who doubt the anthropogenic nature of climate change. Ultimately, the park's use of ambiguity

facilitates a polysemic reading of its stance on climate change, which allows website users of any persuasion to perceive the park's voice as rationally scientific and emotionally neutral.

Enthymemes

In addition to polysemy through ambiguity, the online written text also includes enthymemes that adhere to the discourse of scientific rationalism. Although climate change is expected to have dire consequences in the Sierra Nevada (US EPA, 2015), the text-based voice of Yosemite refrains from articulating these predictions outright, relying instead on enthymemes to suggest that dramatic changes are underway in the park. In this way, the voice of the park remains cool and rational, avoiding any hint of alarmism, and instead allows readers to complete syllogisms privately, coming to any alarming conclusion on their own.

The enthymeme has historically been defined in the Aristotelian rhetorical tradition as "a syllogism having a suppressed premise or conclusion" (Bitzer, 1959, p. 400). A syllogism involves two premises and a conclusion, and an enthymeme usually consists of a stated premise, an unstated premise, and a conclusion, or two stated premises and an unstated conclusion. Thus, enthymemes are "joint efforts of speaker and audience" (p. 408), in which audience members supply the unstated premise or conclusion themselves. In the case of Yosemite's online climate change messages, these enthymemes often lack *both* a premise and a conclusion, relying on audience members' preexisting understanding of climate change to act as the unstated premise, leading to an unstated conclusion that is most often a severe climate change-related ecological outcome. Burke (1985), Ennis (1982), Gough and Tindale (1985), Govier (1991), Walton (2001) and

others have explored the function of enthymemes with more than one missing premise or nonexplicit assumption. They do not, however, offer analysis of enthymemes that consist solely of one premise. I call the use of a single premise to imply a (perhaps alarming) conclusion the single-part enthymeme. Its suppression of both a premise and a conclusion sets it apart from the traditional enthymeme, and its effect also differs from traditional enthymemes, which, according to Bitzer (1959), "intimately unite speaker and audience and provide the strongest possible proofs" (p. 408). Contrary to Bitzer, Walton (2001) pointed out that traditional enthymemes are not always successful; audience members can come to different conclusions than the rhetor intended. Yet the single-part enthymeme definitively prevents the kind of intimate unity Bitzer described. The personal provision of both a premise *and* a conclusion may indeed produce a strong proof in the mind of the reader due to the increased legwork required to come to a conclusion; however, the single-part enthymeme's reliance on the unguaranteed, preexisting knowledge of the audience produces polysemy rather than unity.

Yosemite's website employs the single-part enthymeme extensively. For example, in a passage about ongoing giant sequoia research, readers are left to connect current climatic changes with past warming episodes that featured dramatic fire activity to come to an unstated conclusion about future fire activity. The written text reads:

> California's western Sierra Nevada had more frequent fires between 800 and 1300 than at any time in the past 3,000 years, according to a 2009 study based upon tree-ring research. Scientists reconstructed the history of fire during this droughty period by dating the years in which fire scars were found in ancient giant sequoia trees…These 500 years, known as the Medieval Warm Period, had the most frequent fires in the 3,000 years studied. During this period extensive fires burned through parts of the Giant Forest at intervals of about 3 to 10 years. Any individual tree was probably in a fire about every 10 to 15 years. ("Giant Sequoia Research," Yosemite National Park, 2016, paragraph 6)

This passage functions as a sophisticated enthymeme that depends upon readers'

understanding of the similarities between current warming trends and those that occurred during the Medieval Warm Period, or upon the intellectual connection between a past period of drought and the current one. Those readers who do make this connection ostensibly supply the unstated premise (current warming trends are similar to those that occurred between 800 and 1300) that leads to the unstated conclusion that fire activity is likely to increase significantly to mirror the fire frequency that characterized the Medieval Warm Period. This single-part enthymeme exemplifies the many omissions of premises and conclusions that characterize the park's online written text. This represents a significant departure from the traditional understanding of enthymemes as lacking *either* a premise *or* a conclusion; by relying on preexisting audience understandings of climate science to provide an unstated premise that then leads to an unstated conclusion, the audience is called upon to do even more intellectual legwork to come to conclusions about climate change, a process that creates greater distance between the park and alarming climate change messages.

The use of subtlety in the construction of enthymemes aligns with Crick's (2004) argument that enthymemes can represent "a wholly different style of argumentation, one that establishes a cooperative and constitutive relationship between speaker and audience…" (Crick, 2004, p. 23) and "posits a series of hypothetical conditions and invites us to imagine consequences that ensue" (p. 39). There is no guarantee, however, that readers will in fact imagine dire consequences to the hypothetical conditions (i.e., that current and future climatic conditions will mirror volatile past climatic conditions) suggested in the park's written text, a possibility that is all the more likely given the lack of both a premise and a conclusion. Those readers who lack a working knowledge of basic climate science may not be able to produce the required premises necessary to come

to alarming conclusions, while for those who resist the notion that current climatic conditions are changing significantly, no alarming conclusions are likely to come to mind, or if they do, likely will be rejected as illogical. Single-part enthymemes therefore conform to the "sophistic view" that enthymemes are "essentially polysemic" (Jasinski, 2001, p. 208) because they leave open the possibility of multiple understandings among audience members. Regardless of the reader's position on climate change, however, the park's voice is likely to come across as appropriately rational and scientific. Those who reject climate change as a significant threat are unlikely to read any alarming unstated premises in the text in the first place, while those who do find climate change threatening might come to dramatic conclusions on their own. The park thus avoids obvious apocalyptic predictions, which facilitates an overall rational, measured voice on the website.

Subjunctive

The subjunctive is an important characteristic of Yosemite's institutional voice that is employed in the park's written text to soften otherwise alarming predictions within an overall institutional voice of scientific rationalism. Zelizer (2010) described the subjunctive as a means of evoking "emotionality, contingency, and imagination," which "become particularly useful around events that are unsettled, ambiguous, difficult, contested, or otherwise in need of public consensus" (p. 15).[12] The subjunctive, she argued, is "the mood or voice of a verb used to express condition, desire, opinion, hypothesis, or statements that are contrary to fact" and "grammatically couches what is

[12] Although Zelizer has not applied the subjunctive to environmental crisis, it is a useful framework for understanding climate change, a controversial and inherently contingent phenomenon.

depicted in an interpretive scheme of 'what could be' rather than 'what is'" (p. 14). For example, the Environmental Protection Agency's climate change webpage said, as of early January, 2017, "*If* people keep adding greenhouse gases into the atmosphere at the current rate, the average temperature around the world *could* increase by about 4 to 12°F by the year 2100" (US EPA, 2016, emphasis mine). The conditional combined with a possible future outcome constitutes the subjunctive mode. Particularly because the full climatic consequences of the burning of fossil fuels have yet to be ultimately realized, the subjunctive is an important rhetorical trope that appears frequently on Yosemite's website, and in climate change communication more broadly, to express "liability to change, lack of full determination, and lack of factuality" (Scott, 1999, p. 278) surrounding the uncertain outcomes of climate change.

Yosemite's online text-based voice employs the subjunctive to temper what might otherwise be alarming or apocalyptic predictions. By avoiding a straightforward future tense to describe expected changes to Yosemite's ecosystems, the park uses the subjunctive to create space for the possibility of outcomes that are less dire. An example of the subjunctive on Yosemite's website is found in a passage on the hydrology page. The blurb follows a paragraph on the snow-thaw cycle and reads,

> A dramatic warming of the climate *will* profoundly affect this delicate cycle. Northern California *is predicted* to warm by 3-6°C (5-11°F) by the year 2100, an increase that *will* decrease the annual snowpack volume, melt it earlier, and increase the *potential* for torrential winter rainstorms that *may* cause flooding. ("Hydrology," Yosemite National Park, 2016, paragraph 10, emphasis mine)

This combination of certainty conveyed in the future tense and uncertainty expressed in the conditional and with words like "predicted" and "potential" is illustrative of the subjunctive mode as expressing "states of affairs in which incompletion and contingency…are joined with statement and fact" (Scott, 1999, p. 279). Because it is

impossible to know with certainty how high future temperatures will rise, the subjunctive allows the park to articulate the conditional nature of these predictions, and their potential but uncertain consequences.

This example of the subjunctive, which is common in Yosemite's text-based climate change messages, again functions to preserve the rational scientific voice of the park through the use of polysemy. The text does not indicate with certainty what the consequences of climate change are expected to be, but instead articulates a range of possible conditions. It is left to the reader to conclude what effects those conditions might produce. In this way, readers who are predisposed to apocalyptic perspectives on climate change will supply their own dire conclusions, while those who are unconcerned or unconvinced of the severity of climate change likely will not. Thus, any apocalyptic understanding of the effects of climate change on Yosemite's ecosystem will be in the reader's own voice, not in the park's voice, which remains emotionally neutral and rational.

Through the use of polysemy facilitated by ambiguity, enthymemes, and the subjunctive, Yosemite's text-based institutional voice maintains a scientifically rational tone that is characterized by cautious avoidance of certain pronouncements of future changes and a lack of value-laden or emotional language. The distinct way of putting words together that constitutes Yosemite's online written voice lacks pathos and creates a dry, scientific voice—logos—that remains rational and seemingly undisturbed by climate-driven changes. This voice is closely aligned with the emotionally neutral scientific ethos and mirrors the appearance of objectivism that marks scientific publications.

In-Park Texts: Precautionary Rhetoric

The texts physically located in Yosemite, including wayside signs, interpretive displays, and *The Yosemite Guide*, rely on many of the same strategies as the written text on the park's website, including strategic ambiguity, enthymemes, and the subjunctive. In this way, these texts retain the elements of scientific rationalism that characterizes Yosemite's online voice. However, in-park texts use these strategies in combination with an emphasis on the irreparable, creating a voice that speaks a discourse of the precautionary. The overall effect is the construction of a contingent future, which might be characterized by the richness of the present or diminished, depending on the conditions that prevail. This strategy has the potential to motivate action to address climate change on the part of the audience; however, the precautionary rhetoric of in-park texts is so tempered by ambiguity that its persuasive force is largely lost.

The loci of uniqueness, precarity, and timeliness—the loci that together make up the loci of the irreparable (Cox, 1982; Pereleman & Olbrechts-Tyteca, 1969)—are evoked repeatedly in Yosemite's in-park texts. For example, the following paragraph appears on a wayside interpretive sign near Cook's Meadow, in Yosemite Valley:

> Wetlands like this one have likely been here for the last 10,000 years, providing homes and food for a great variety of plants and animal species. In Yosemite, wetland areas make up only about 3% of the landscape, but are estimated to harbor up to one-third of all plant species in the Park. They also capture, store, and release melting snow, extending the availability of life-giving water during the dry summer months.
>
> Here in the Sierra Nevada Mountains and across the globe, wetlands are disappearing rapidly. Effects from trampling, development, and climate change threaten to alter the delicate wetland ecology forever. In Yosemite National Park, park managers work to prevent loss of wetlands by preserving wetland areas and building boardwalks to help minimize damage from visitors.

This sign first establishes the unique or special qualities of Sierra meadows: they provide

habitat for plants and animals as great sites of biodiversity and act as water reservoirs. Furthermore, they are unique in that they are rare; they make up only a small percentage of Yosemite's landscape. Next, the text establishes the precarity of the meadow, which also contributes to its unique quality: meadows like this one are "disappearing rapidly." The precarity of the meadow also functions enthymematically to establish the element of timeliness for wetland preservation; rapid action must be taken to save rapidly disappearing meadows.

The possibility of a diminished future if wetland loss continues, along with the emphasis on the interconnections of the elements of the ecosystem and the warning example of staggering wetland loss due to climate change and other factors, make this sign an example of precautionary rhetoric. However, its use of the enthymeme to argue for timely action to preserve meadows, and its focus on minimizing the effects of trampling rather than the effects of climate change, makes it a weak example of persuasive climate change messaging. Only audience members with a working knowledge of climate science will know that climate change is one of the most serious threats to wetlands and has already contributed significantly to wetland loss (Gonzalez, 2016; Society of Wetland Scientists & U.S. Fish and Wildlife Service, 2008; Sofaer et al., 2016). Without this understanding of climate change effects and a grasp of the kinds of actions necessary to prevent increased climate change, readers of this sign will not be empowered with the knowledge of how to contribute personally to meadow preservation in the face of climate change.

Another example of potentially persuasive precautionary rhetoric hampered by ambiguity is in the February, 2016 edition of the *Yosemite Guide*. This article, about the role of large, old-growth trees in Yosemite's ecosystems, closes with the following

paragraphs:

> Big trees and the old growth groves they inhabit not only inspire awe and reverence in humans, they provide unique ecological services. For example, Sierra great gray owls only use the broken tops of dead giants for their nests. Big trees also sequester large amounts of carbon from the atmosphere…
>
> Big trees are a phenomenon of favorable climate conditions and benevolent history. According to forest demographers, they are rare and becoming rarer as the western US climate gets drier and experiences more extreme weather. In Yosemite, big trees are all around you, so enjoy them while you, and they, are here. (Colwell, 2016, p. 10)

In this example, big trees are explicitly identified as unique due to the roles they play in the ecosystem, and earlier in the article for their "gigantic size." Their precarity is established in the explanation of their increasing rarity due to drought and "more extreme weather," and earlier in the article in a discussion of the "current brutal drought and several recent wildfires" that "have killed thousands of pine and fir trees in Yosemite" and paved the way for bark beetle infestations. The element of timeliness is established with the injunction to enjoy them while they last. However, timeliness as it relates to action to address climate change is missing. Bark beetle infestations and subsequent mortality among big trees are facilitated by the warming temperatures brought on by anthropogenic climate change (Fettig, 2012); however, the *Yosemite Guide* article treats these tree die-offs as "natural calamities" that "are part of the natural oscillation between phases of forest advance and retreat, and an appropriate component of a protected landscape" (Colwell, 2016, p. 10). The anthropogenic nature of climate change is only subtly alluded to in the sentence about the ability of big trees to "sequester large amounts of carbon from the atmosphere," an important function considering the ever-increasing levels of CO_2 put into the atmosphere by humans. By highlighting the "naturalness" of the current die-off, the article obscures the role of human action. Although the article

makes clear that these stands of big trees are threatened and precaution is advised, ambiguity regarding the causes of the spike in tree mortality also conceals the ways that those causes might be mitigated through a change in human behavior.

Both of the above text fragments fall short of the persuasive potential of the precautionary framework and its use of the irreparable to motivate a particular action. According to Cox (1982), the persuasive force of the irreparable lies in its connection to human choice. He argued, "That which is threatened *need not be lost if one acts as the rhetor requests*" (p. 230, emphasis in the original). In these text fragments, however, the rhetor has positioned particular park resources as irreparable but stops short of making a request of the audience. The texts therefore lack the important feature of precautionary rhetoric as empowering to the audience through the provision of "information and resources" for action (Patrick, 2007, p. 146).

Other text fragments more clearly articulate the conditions of irreparability and their connection to anthropogenic climate change and come closer to making a request of the audience for mitigating action, leaving open the possibility of an undiminished future through the use of the subjunctive. One wall of the visitor center in Yosemite Valley is dedicated to the potential effects of climate change on particular park species, including pika, monarch butterflies, great gray owls, and rainbow trout. Each of these species is positioned as unique, precarious, and in need of timely action to be saved. In the first panel of the exhibit, which acts as the introduction, these elements of the irreparable are brought together with a call to action, albeit a vague one. This introductory panel is titled "Ripple Effects," and features white text over a dark blue image of water rippling out in concentric circles from a single center point. The text reads,

> Animals and plants in a community relate to and depend on each other. Changes

> in temperature, humidity, water, and fire help some species to flourish and others to decline. In some places, species can only survive within a narrow range of conditions. Rapid and dramatic changes can cause a species to become extinct. Because of the interconnections between species, changes can ripple through an entire ecosystem—sometimes with unexpected results.
>
> Yosemite's climate has cooled and warmed over time…Currently, the climate is warming again, but this time at an unprecedented rate. Scientists agree that human-caused greenhouse gas emissions are causing the warming of the earth's climate. Can we reduce these emissions in time to slow this trend?

This panel exemplifies precautionary rhetoric with its emphasis on whole ecosystems, uncertainty about precise climate change effects, and potential for a diminished future. Its reference to extinction is a prime example of the irreparable since, as Cox (1982) noted, extinction cannot be undone. The panel asks readers to help "reduce emissions in time to slow this trend," representing a call to action that might prevent a diminished future of "dramatic changes" and species loss. The use of a question underscores the subjunctive mode used in the first paragraph's discussion of the conditions that "can," but also may not, lead to extinction. In this way, the future is left open to several possible outcomes, which are contingent on the actions of the audience members to reduce emissions. Again, however, this piece of text relies on the reader's preexisting basic knowledge of climate science, including which gasses are greenhouse gasses, and which human activities create emissions. For those readers who lack this knowledge, the panel's closing question is an ineffective call to action, although its ambiguity may prevent it from alienating visitors who doubt the threat of climate change.

Yosemite's in-park texts use a voice of precaution to warn of possible meadow loss, species extinction, decreased snowpack, prolonged drought, and other potential risks associated with a warming climate. These texts emphasize the "ripple effects" that characterize closely connected ecosystems and the possibility of unknown consequences

for the whole if one part of the ecosystem is affected by climate change. However, these consequences are not foregone conclusions, and the possibility remains that readers will take the necessary actions to prevent the diminished future against which these texts warn. Thus, the subjunctive mode again plays an important role, but with a different effect from the written text on the park's website. Instead of merely leaving open multiple possible outcomes in order to align with the cautious scientific ethos, in-park texts also provide a sense of hope that human actions can prevent the potential losses described. Yet, without providing information about sustainable actions that could prevent these losses, these texts fall short of the persuasive potential of precautionary rhetoric. In-park texts demonstrate that this form of cautious or mild precautionary rhetoric can be compatible with the rational scientific rhetoric that characterizes the voice of the park's online written text. Even though these texts move toward pathos through their use of the irreparable and allusions to loss, they remain dispassionate and avoid the appearance of alarmism by refraining from making certain pronouncements of the consequences of climate change and prescriptions for human behavior. They avoid taking a strong stance on the threat posed by climate change and, like the voice of Yosemite's online written text, appear largely outside the perceived controversy of the issue and aligned with the image of the rational scientist speaking.

Online Videos: The Embodied, Personalized Voice of Apocalypse

Although dominant, this rational text-based voice is not the only voice that speaks for Yosemite National Park. In addition to the written voices that appear on every page of the park's website and on the materials physically located in Yosemite, a number of individual, embodied voices of employees and park residents also contribute to the

broader, polyphonic institutional voice, and thus it is not sufficient to characterize it as uniphonically rational. These voices, conveyed via online videos, clearly originate in individual, embodied subjects whose visible, physical selves are captured and displayed onscreen. These voices stray from the cautious and rationally scientific ethos that characterizes the disembodied voice of the website's text and the cautious precautionary voice of in-park texts, instead engaging in apocalyptic rhetoric and conveying personal emotions. These voices for the most part do not employ the subjunctive to soften predictions of negative future changes, relying instead on a straightforward future tense to convey irreversible ecological shifts that are already in motion, transforming the apocalyptic from a purely future state of affairs into a current reality whose incursion into the present serves as a warning of all that is to come.

The videos that feature these voices are most often a combination of scenic footage with narration or a musical score, interspersed with park employees and residents, who have expertise in the relevant topic and provide more in-depth information, their names and job titles appearing beside them on the screen. Appearing as they do, often in uniform and with job titles identifying them as both experts in their fields and usually as employees of the National Park Service, these individuals are seen as representatives of the park, who speak on behalf of the organization and whose voices are part of the broader polyphonic voice of the institution. It is these embodied, personalized voices that allow the park to articulate not only a rational scientific environmental discourse, but also a more emotional, apocalyptic discourse.

Moments of apocalyptic rhetoric and personal narrative appear most frequently in videos whose topics relate to environmental features that are obviously impacted by climate change: snow, glaciers, water, and fire. The individuals featured in these videos

provide similar types of anecdotal testimony as the employees who did so in interviews (see Chapter II), demonstrating that this form of anecdotal evidence can be used by individuals speaking for themselves and those positioned to speak for the institution. For example, Greg Stock, the park geologist, describes in one video the retreat of Yosemite's two remaining glaciers, which continually recede to higher and higher points on Mt. Lyell, the tallest peak in the park. He then uses this glacial retreat as a metaphor for high-elevation plant and animal species that are also affected by warming temperatures:

> There are a number of plants and animals that are doing effectively the same thing. And the ones that are living at the very highest peaks of the park, eventually they've got nowhere to go…When the temperatures get a lot warmer, they're not going to be able to go anywhere, and like the Lyell Glacier here, they, too, may disappear. ("Yosemite Nature Notes: Glaciers," Yosemite National Park, 2010)

This description of the impending extirpation of high-elevation species, along with the iconic Lyell Glacier, amounts to apocalyptic rhetoric, in that it gestures toward the "imminent demise" (Peeples et al., 2014, p. 229) of irreplaceable features of the park.

Perhaps the most notable element of Stock's segment, quoted above, is the absence of the subjunctive. He uses the present tense to indicate that the retreat of high-elevation species is already occurring; it is not a possible negative consequence of climate change that *might* occur in the future. In this way, he removes the possibility of a different, less bleak outcome. Warming temperatures constitute the demise of species whose existence depend on the cooler temperatures that once characterized their habitat; for those individuals, like Stock, who care about these species, loss of these species is similarly perceived as apocalyptic.

This apocalypse is underscored by mountain guide and area resident Josh Helling (who appears alongside Stock in the video) when he says of the rapidly melting Lyell

Glacier, "It's almost like watching Half Dome melt away or dissolve" ("Yosemite Nature Notes: Glaciers," Yosemite National Park, 2010). Yosemite National Park would be unimaginable without its most recognizable natural feature, Half Dome, the loss of which would be a blow to many Americans who identify the icon with the National Park Service and "America's Best Idea."[13] Here, Half Dome functions as a synecdoche for Yosemite as a whole, standing in for the destruction that awaits the entire park as climate change unfolds. Helling's association of the Lyell Glacier with the far more famous (and durable) Half Dome is a move toward the apocalyptic, as the dissolution of Half Dome could only be the result of some extreme natural disaster or act of God. By connecting the disappearance of the glacier with the hypothetical destruction of an iconic dome, Helling casts climate change as just such a disaster.

Helling's use of the dissolution of Half Dome as a metaphor for the loss of the Lyell Glacier is, on its face, absurd. Half Dome is made of granite and is largely impervious to the threat of warming temperatures. Although many elements of the park are threatened by climate change, Half Dome is not one of them, and the implication that Half Dome and the Lyell Glacier have this in common casts doubt on the claim that climate change really threatens either one. However, the metaphor begins to make more sense when Helling's own emotional connection to the glacier is taken into account. He reveals in the video that he has hiked to the highest peak in the park to see the Lyell Glacier many times over the course of 20 years. He is attached to the glacier, his metaphor suggests, in the same way many Americans are attached to the far more iconic Half Dome. The loss of

[13] In a 1983 speech, Wallace Stegner originally articulated the notion that America's national parks represent the country's best ideas and attributes. In 2009, Ken Burns directed a documentary series on the National Park Service entitled *The National Parks: America's Best Idea*, which features a picture of Half Dome on the cover of the boxed set. This association is no accident: Yosemite has long been hailed as the "crown jewel" of the National Park Service.

the glacier feels to him as cataclysmic as the loss of Half Dome would feel to most visitors. This revelation of personal connection to the glacier is not aligned with the disinterested, objective ideals of the scientific ethos, in which such attachment might be seen as an impediment to unbiased research. Instead, like the anecdotes used by employees in interviews, it constitutes emotional, individualized testimony whose power is found not in its disinterestedness, but in its empathy-evoking status as eye-witness narrative.

Like the already-retreating glaciers in Yosemite, fire is another ecological feature that is used to illustrate the already-visible, apocalyptic effects of climate change in the park. In a video about the Rim Fire, the largest recorded wildland fire in California history, which affected large swaths of Yosemite, climate change is directly and explicitly linked to increased fire frequency and intensity. In this video, Tom Medema, the park's chief of interpretation at the time, appears in uniform to talk about the Rim Fire. As he speaks, images of smoke-engulfed firefighters and blazing landscapes roll across the screen. Over these images, Medema's voice says matter-of-factly,

> The Rim Fire is just the most recent example of these really large, catastrophic wildfires that we're seeing more and more of in the Sierra Nevada. These dry, dry forests are burning far more frequently and far more rapidly than they did in the past. So we can draw a direct correlation between climate change and the droughts that we're seeing as a result and these resulting larger wildfires. ("Yosemite Presents: Rim Fire," Yosemite National Park, 2015)

In this segment, Medema refrains from using the subjunctive, instead employing the present tense to cast climate change as a current, rather than a future, event. By removing climate change from the realm of the future and placing it squarely in the present, he preempts any possibility of an alternative future in which climate change effects are less dire than predicted. These effects are decidedly in the realm of the apocalyptic: "really

large, catastrophic" fires burn "far more frequently and far more rapidly than they did in the past," and there is no end in sight to this inferno-esque pattern, which is visualized in the video. Medema thus shifts the temporal orientation of the apocalyptic mode from the future to the present. This is a significant adaptation of the apocalyptic, which is by definition "an *epochal discourse*" that "accords weight to actions and events in history by mediating the relationship between past, present, and future" (O'Leary, 1993, p. 79, emphasis in the original). As the effects of climate change are moved from the future into the present, the relationship between epochs is remediated. Climate change becomes a current *and* future threat; the Rim Fire becomes a sign of the times, simultaneously wreaking havoc in the present and foreshadowing the destruction that is to come as climate change stretches into and intensifies in the future.

These videos' images of threatened nature are made to appear apocalyptic by the human voices that narrate them. As Condit (1990) pointed out, verbal commentary in videos "artfully tells the viewer what to see" (p. 87). In the case of the video on glaciers, viewers might not even understand that the patches of snow depicted *are* glaciers if it were not clarified by the verbal commentary, since they differ dramatically from the more classic image of the arctic glacier as a sheer, cliff-like face of ice. The voices of the commentators, however, not only tell viewers to see the ice patches as glaciers, but also "[instruct] the audience in the proper emotional reaction to the film" (Condit, 1990, p. 87). Images of running water are contextualized by the commentating voices as glacial melt water, which becomes apocalyptic only in the context of Helling's comparison of the Lyell Glacier to Half Dome, which in turn instructs the viewer to understand the loss of the glacier as both dramatic and tragic. Likewise, Medema instructs the viewer to see the images of fire that populate the video, not as "normal," "natural" wildfires that

occurred historically, but as apocalyptic wildfires, that are “really large” and “catastrophic.” The images of burning trees do not argue by themselves that these kinds of wildfires are now burning “far more frequently and far more rapidly,” but become symbolic of this fiery apocalypse only in the presence of Medema’s verbal commentary describing them as such. In this way, the images that accompany these embodied voices become evidence for the distressing claims made by the voices, providing support for the notion that the apocalyptic consequences of climate change are already here and visible.

O’Leary (1991, 1994, 1997), O’Leary and Macfarland (1989), Peeples et al. (2014), and others have tended to apply the label *apocalyptic* in a pejorative way to groups (often fringe groups) that use unfounded claims or unlikely scenarios to whip up hysteria. However, Foust and Murphy (2009) argued that climate change is one topic that has prompted apocalyptic rhetoric in the mainstream press. They argue that apocalyptic framing of climate change is appropriate and can be productive when the rhetor stresses the role of human agency in averting the looming climate catastrophe. But this interpretation depends on the traditional, future orientation to the apocalypse, whose subjunctive nature means that it might be avoided. For the individuals who testify to the present catastrophe of climate change in Yosemite, the apocalypse cannot be entirely avoided because it is already underway. This framing of climate change may not promote human action in the way Foust and Murphy advocate, but it should not be discounted as ineffective; witnesses to the current and apocalyptic nature of climate change offer important testimony of the seriousness of the problem. As elements of the broader, polyphonic institutional voice of the park, these voices are an important counterpoint to the rational scientific and cautiously precautionary voices conveyed in Yosemite’s written texts. They challenge the dominating voices of scientific rationalism and, through

their use of ethos and sense of urgency, highlight climate change as a serious threat in a way the other voices do not. The result is decidedly mixed; audience members might justly accuse Yosemite of sending mixed messages regarding the causes and threat level of climate change. While its text-based voices dispassionately lay out all that could be lost in a warming climate, embodied voices conveyed via video express distress over these losses and portray them as apocalyptic. Yet the compelling nature of embodied, first-person testimony is undercut by the dominating voices of scientific rationalism, which downplay the threatening nature of climate change, and ultimately, none of these voices offer a clear call to action. However, the presence of individual voices of apocalypse (subordinated as they may be to other voices) is a step toward aligning Yosemite's overall institutional voice with the position of the National Park Service that climate change is, indeed, a dire threat.

Implications

This chapter is a step toward describing the cultivation of institutional voice, which can articulate multiple environmental discourses in the attempt to disseminate climate change information. My analysis sheds light on three particular competing discourses all produced by a single, but polyphonic, institution. It draws attention to specific mechanisms of rational scientific, precautionary, and apocalyptic discourses, and highlights the relationship between these competing rhetorics.

Yosemite's online written text articulates a discourse of scientific rationalism. The primary strategy of this voice is polysemy, which maintains an air of disinterested scientific rationality while allowing readers with incompatible views on climate change to insert their own perspectives into the broad language of the text. This polysemy is

achieved through ambiguity, particularly regarding the causes of climate change; the single-part enthymeme, which relies on readers' preexisting knowledge of climate change to produce alarming conclusions rather than stating alarming conclusions outright; and the subjunctive mode, which leaves the future open and facilitates a range of possible conclusions that depend largely on the reader's own understanding of climate change and the threat it poses. My analysis of these rhetorical moves contributes to the study of the rhetoric of science by theorizing the single-part enthymeme and bringing together the literature on climate change communication with that on polysemy and the subjunctive. Ultimately, it sheds light on the ways in which an institution can deploy scientific rationalism to distance itself from controversy.

Yosemite's in-park texts use precautionary rhetoric that moves toward pathos without undermining the voice of scientific rationalism. Avon and Hirokawa (2001) called for further analysis of the persuasive potential of the precautionary. This chapter begins to answer this call. I have offered a theory of the precautionary as it relates to loci of the irreparable, in which the voice of in-park texts positions Yosemite's resources as unique, precarious, and in need of timely action in order to be preserved. The permanence of loss of precious objects is an important consequence of climate change, which is tied closely to species extinction, habitat loss, and permanently-altered ecosystems (Gonzalez, 2016; IPCC, 2014). If, as Pereleman and Olbrechts-Tyteca (1969) and Cox (1982) argued, the fear of irreversibility is a strong motivating force, it stands that the irreparable can be an important rhetorical strategy for climate change communicators attempting to persuade an audience to take action to preserve that which is unique, precarious, and temporally threatened. The analysis of Yosemite's in-park texts demonstrates the ways in which this strategy can fall short when overly ambiguous or cautious. These texts fail to provide a

concrete call to action that might galvanize readers to participate in the preservation of precarious resources. In order to increase the likelihood of prompting action on the part of audience members, rhetors using the precautionary should clearly articulate irreparability and its relationship to a diminished future while *also* supplying a clear set of actions that, if taken, constitute a choice in favor of preservation of the irreparable. Additional case studies are needed in order to understand what a more fruitful use of the precautionary might look like.

The embodied voices that bear personal witness to the already-present apocalypse of climate change stand in sharp contrast to the rationally scientific and precautionary voices of Yosemite that are conveyed in the park's written texts. My analysis demonstrates the ways in which personal narratives, imbued with the pathos of personal connection to the resources and the ethos of the eye witness, can shift the apocalypse from the future to the present and recast current events as both evidence of an ongoing apocalypse and foreshadows of events to come.

However, the individual voices that articulate the apocalyptic are secondary to the rational and cautious text-based elements of the park's voice, for two reasons. First, these voices are far less prominent than the other voices simply by virtue of their positioning in the website's structure. Although linked to various other pages, these videos are located primarily on a single subpage devoted to multimedia. Website users must navigate to this page and chance upon one of the videos related to climate change (most of the videos on the site do not reference climate change at all) in order to hear these voices in the first place. Glancing at the webpage, casual users are unlikely to come across the particular videos featuring these embodied voices that articulate an apocalyptic or personal relationship to climate change. The text-based voice of the park, by contrast, is featured

on every page. Website users are therefore far more likely to encounter this voice when browsing the site. Once in the park, visitors who read signs and handouts and peruse interpretive displays will encounter primarily this same rational, scientific voice. When these texts do stray from the strictly rational scientific in a move toward the irreparable, they do so cautiously and without specific calls to action, creating a voice of precaution that is far more rationally scientific than apocalyptic.

Second, the voices expressed in the online videos are those of individuals, while the voices expressed in the website's writing and in-park texts are usually unattributed to any particular person. Although most of the individuals who appear in the videos are wearing National Park Service uniforms and are positioned as speaking for the park, they are just as likely to be perceived as speaking primarily for themselves, since these voices are so closely connected to the individual, physical bodies to which they are shown to belong. Viewers *see* the bodies that produce these voices, and *hear* the unique vocal qualities of each. Their articulations of climate change might therefore be dismissed as personal opinion rather than official institutional standpoint.

The text-based voices, by contrast, can be attributed to the monolithic organization, since most traces of personal authorship have been erased. The disembodiment of the written text allows it to speak for the multiplicity of bodies that constitute the institution of Yosemite National Park. The result is the dominance of the text-based voices characterized by scientific rationalism and mild precaution.

Conclusion

Yosemite's voices of scientific rationalism and mild precaution are at odds with the position of the National Park Service that climate change is urgent, anthropogenic, and

*"*fundamentally the greatest threat to the integrity of our national parks that we have ever experienced" (National Park Service, 2010). While maintaining the appearance of dispassion and distancing itself from strong statements about the anthropogenic and threatening nature of climate change, Yosemite's text-based voices pass up the opportunity to motivate the sustainable action the National Park Service claims to want. Ultimately, Yosemite's institutional voice is primarily one of scientific rationalism due to its pervasiveness and the muting factors that mediate the relationship between the individual and text-based voices of the park. However, these texts reveal the polyphonic nature of Yosemite's voice and demonstrate the ways in which a single institutional voice can articulate multiple environmental discourses. The use of the personal, embodied voices to express the more extreme and distressing rhetoric of environmental apocalypse effectively distances the larger institution from this more controversial discourse, allowing the park to align itself first and foremost with the safer, more agreeable rhetorics of scientific rationalism and mild precaution. The communal nature of voice is evident in the ways in which Yosemite positions its voice to align primarily with the values of the broader scientific community while simultaneously using members of its own community to articulate, quietly, an alternative environmental discourse. By utilizing these diverging discourses, Yosemite's voice becomes palatable to a wider audience. In this way, polyphony becomes the mechanism of polysemy, whereby audience members, regardless of personal stance on climate change, will find a voice that speaks to them.

CONCLUSION

Climate change represents a serious threat to human and other communities, with the potential to fuel drought and famine, refugee crises, flooding, and growing poverty (IPCC, 2014). Yet the United States so far has failed to enact meaningful policies to address climate change, and the American public is perceived as largely unconcerned about it (Hamblyn, 2009). However, according to recent polling by the Pew Research Center, 36% of Americans "care a great deal" about climate change, and an additional 38% "care some" (Funk & Kennedy, 2016). This significant percentage of increasingly concerned citizens is an important first step toward effective policies and personal actions to curtail greenhouse gas emissions. Public lands sites can contribute to this positive shift by facilitating greater climate change education and engagement (Schweizer et al., 2013). Indeed, many visitors and employees in Yosemite National Park already articulate connections between their experiences with the park and their perceptions of climate change as a current and local threat.

This analysis has explored these articulations, examining the ways in which visitors, employees, and the institutional voice of the park construct scientific and place-based arguments about the nature of climate change, both in the park and more broadly. Visitors to Yosemite draw on sense of place to marshal icons from the local environment to make verbal-visual arguments about the nature of climate change as threatening, benign, or ambiguous. Park employees, many of whom are intimately familiar with the park as long-

standing residents, use personal anecdotes of lived experience as evidence in scientific arguments that blend the personal and technical spheres of rhetoric. The polyphonic institutional voice of the park uses multiple subvoices to articulate a number of competing environmental discourses, including the rational scientific, the precautionary, and the apocalyptic, each of which paints a different picture of the severity and immediacy of climate change. Together, these voices provide a diverse set of understandings and portrayals of how climate change plays out in the rhetoric of Yosemite National Park, and demonstrate the persuasive potential of combining scientific rhetorics with other, more personal and narrative forms of discourse.

Implications: A Synthesis

The diverse forms of argument produced by the multiplicity of voices that interact with one another in Yosemite reveal that scientific arguments about climate change come from a variety of sources beyond traditional technical experts, blurring distinctions between technical, public, and private spheres of rhetoric (Goodnight, 1982). Furthermore, texts produced by Yosemite National Park, an institution that represents traditional technical expertise, reveal not only traditional forms of scientific argument, but also other environmental rhetorics that persuade in alternative ways and employ alternative forms of knowledge. In order to contribute to a better understanding of effective means of engaging publics on climate change, it is crucial to study the diversity of sources and rhetorics of climate change arguments.

My analysis sheds light on the role of multiple forms of knowledge in the articulation of climate change, particularly the relationship between local and scientific knowledge as often complementary ways of understanding and conveying climate change. Local and

experiential knowledge of perceived climate change effects provide an important counterpoint to purely technical explanations of the phenomenon. I have sought to complicate the distinction between the technical and nontechnical, expert and nonexpert, and bring attention to the diversity of evidence and voices used in climate change arguments by a variety of rhetors. Ultimately, each of the voices examined here highlight the importance of place in fostering perceptions of climate change as both a local and current threat. These voices concretize climate change by linking its perceived effects with particular local environments, drawing on sense of place to craft scientific arguments about climate change. This has a number of implications for climate change communication. First, it sheds light on the complex relationship between the multiple forms of knowledge and expertise at play in the construction of climate change arguments, highlighting the importance of sense of place and local knowledge for perceiving climate change effects. Second, it challenges the notion that climate change is too abstract and complicated to be grasped effectively by lay publics, because it demonstrates that they already perceive its effects on the local level. Finally, it reveals the potential of public lands to serve as catalysts for climate change engagement.

Multiple Forms of Knowledge

Although Yosemite's employees and in-park texts often draw on scientific knowledge to communicate about climate change, local knowledge also plays an important role in the articulation of climate change, for both park visitors and employees. A number of scholars have critiqued the privileging of scientific knowledge over local knowledge (Brossard & Lewenstein, 2009; Endres, 2009; Fischer, 2000; Kinsella, 2004; Kinsella & Mullen, 2007; Taylor & de Loë, 2012; Wynne, 1989). Fischer (2000) has argued,

> Not only are the intentions and motives of the locals essential to a proper understanding of a situation, but they also typically possess empirical information about the situation unavailable to those outside the context. While such local knowledge cannot in and of itself define the situation, the "facts of the situation" are an important constraint on the range of possible interpretations…Given this interpretive dimension, science loses its privileged claim as superior knowledge. (p. 45)

The experiential knowledge of locals, therefore, is crucial to fully understanding the situation of climate change. Employees and visitors of the park possess experiential knowledge of the phenomenon, and interpret their experiences of change to be the effects of climate change. While it may be technically impossible to prove definitively that climate change is indeed the sole cause of these observed changes, narratives of lived experience are persuasive in their own right. Individuals who perceive and describe the effects of climate change as here and now represent a largely untapped source of eye witness testimony to the subtle, gradual, on-the-ground shifts that accumulate into dramatic and permanent environmental degradation. Together, the accounts of these changes create an accessible, persuasive narrative about climate change as a lived phenomenon rather than a purely abstract, scientific one. These narratives can and should be coupled with scientific explanations of climate change in order to highlight the personal, lived consequences of climate change and create more holistic, compelling accounts of climate change.

Public Understanding of Climate Change

In addition to exploring the ways nonexperts articulate climate change using icons, narratives, and blended rhetorics, this analysis highlights the ways in which the National Park Service as an institution of scientific expertise deviates from traditional scientific argument, using multiple forms of media to articulate differing visions of climate change,

not only as a purely scientific phenomenon, but also as a threat to the future of the park's environment and a force of apocalyptic destruction here and now. These alternative discourses complicate the notion of the scientific expert as disinterested, purely rational, and emotionally neutral and reveal the potential of precautionary and apocalyptic rhetorics that are combined with scientific rhetorics in the articulation of climate change as more than merely an abstract scientific process.

Although the scientific mechanisms of climate change are abstract and complex, the local climate change icons invoked by visitors and the anecdotes of lived climate change experience related by park employees demonstrate that climate change can be concretized and articulated by nonscientists. This challenges the notion that climate change is so complex that it is outside the grasp of public understanding. Much research has focused on the need to make climate change locally relevant in order to make it more concrete and comprehensible to lay publics (Leiserowitz, 2005; Leiserowitz et al., 2014; Lorenzoni et al., 2007; Schroth et al., 2014; Sheppard, 2011; Uzzell, 2000). Yet my research has shown that visitors and employees of Yosemite National Park, including those who do not identify as scientific experts, already perceive the effects of climate change in the park and independently and spontaneously invoke concrete visual icons and anecdotes of local change. The ability to articulate such icons and anecdotes depended not on participants' complete grasp of the all the intricacies of climate science, but on their sense of place and personal experiences in Yosemite. Perceptions of climate change, then, do not depend solely upon traditionally conceived scientific literacy, but largely on connections to place over time. These connections to place facilitate sensitivity to environmental changes in a way that mere knowledge of the carbon cycle cannot.

This is not to say that scientific literacy is unimportant in public understanding of

climate change. Indeed, many visitors who invoked local icons to articulate their perceptions of climate change also expressed uncertainty about the scientific processes of climate change, skepticism toward the scientific community, and misunderstandings of the anthropogenic nature of climate change. This incongruity indicates that sensitivity to environmental changes, rooted in sense of place, does not automatically lead to accurate understandings of the phenomenon or to sustainable actions to mitigate climate change. This is illustrative of Relph's (1997) argument that sense of place does not, in and of itself, necessarily lead to proenvironmental behavior. Some technical competency is needed to facilitate connections between observed environmental changes, comprehension of the causes of those changes, and actions to mitigate those changes. Yosemite's interpreters exemplify this point. While many lack formal technical training in the sciences, their jobs require a certain level of technical competency. All of the employees I interviewed possessed the technical knowledge necessary to grasp the basics of climate science *and* the local, place-based knowledge necessary to testify to the current local effects of climate change. As a result, they understood the severity of the threat of climate change in the park and knew what personal and collective action is necessary to mitigate this threat. This demonstrates that place-based arguments and scientific arguments are both important for climate change communication, and should be used together to promote effective climate change engagement. The challenge to climate change communicators, then, is not only to make climate change locally relevant and concrete, but to persuade lay publics that human behavioral changes are crucial to halt the environmental degradation that many members of publics already perceive.

Public Lands as Contexts for Climate Change Education

Public lands are important contexts for these appeals. According to Schweizer et al., (2013), "messages about climate change complexity and impacts resonate when they are…integrated with the experiential meaningfulness of place" (p. 43), particularly public lands. Interviews with Yosemite's visitors show that they do indeed have meaningful experiences of place in the park, which lead them to perceive and articulate local climate change effects. Climate change communicators in Yosemite National Park, therefore, have a significant opportunity to disseminate relevant messages that make connections between climate science, the park's environment, visitors' sense of place there, and specific actions to mitigate climate change. Yet the texts produced by the park largely miss this opportunity. Online written texts rely almost entirely on a rhetoric of scientific rationalism, failing to tap into readers' sense of place or lived experience, and avoiding discussions of human behavior as a cause or potential solution to climate change. Yosemite's in-park texts and online videos move toward connecting lived experience of place with climate change effects, but fall short of the persuasive potential of precautionary and apocalyptic rhetorics by again avoiding specific calls to action to address climate change. Visitors' sense of connection to Yosemite and perceptions of local climate change impacts therefore go untapped as potential motivating forces for sustainable action.

However, it is possible, particularly given the ever-changing political climate, that Yosemite's primary goal is not necessarily to persuade visitors of the reality or importance of climate change. Considering the diverse audience for park-produced texts, there are certainly benefits to maintaining a predominantly rational scientific voice and appealing to the broadest possible audience, including both climate change believers and

skeptics, through the use of polysemy, ambiguity, and enthymemes. Although this approach may not facilitate significant climate change engagement or engender a sense of personal responsibility, it may help preserve the image of Yosemite as nonpartisan and apolitical, which likely comes with its own benefits for the park.

Yet the avoidance of strong persuasive messages about climate change does not lessen the importance of Yosemite and other public lands sites as contexts for public climate change engagement, whether messages come from the National Park Service or other environmental organizations operating in national parks. Visitors' perceptions of climate change as a current force of change to the park's environment could be a valuable starting point for more thorough climate science education and the fostering of a sense of personal responsibility. If the National Park Service chooses not to take advantage of this opportunity (or is forbidden from doing so by larger political forces), nongovernmental environmental organizations could instead take on the responsibility of educating publics about climate change, using visitors' sense of place in public lands as a starting point.

Limitations and Directions for Future Research

This analysis contributes to the existing body of research on climate change communication and local knowledge, particularly in its application of these topics to the national park setting. However, this research has several limitations. First, as noted in Chapters I and II, as a rhetorical project employing qualitative methods, the number of interviews conducted was relatively small. Close readings of these interviews and the field notes produced has garnered valuable insights into the climate change rhetorics of Yosemite visitors, employees, and written texts. More research is needed, however, to see whether my findings hold across larger numbers of visitors and employees. Additional

research using a social scientific approach and a larger sample size would be valuable in this regard.

Second, a number of unusual circumstances were occurring in Yosemite National Park during the time I conducted my research. 2016 was the centennial anniversary of the National Park Service, and visitation was especially high to national parks across the country, likely as a result of the centennial celebration. This may have altered the usual makeup of park visitors. Additionally, 2016 was one of the driest and hottest on record in California, and was the fifth consecutive year of drought in Yosemite, potentially influencing perceptions of climate change. Finally, one of the park's major attractions, the Mariposa Grove of Giant Sequoias, was closed in 2016 due to a 2-year restoration project. The Mariposa Grove, like the rest of the park, has already been impacted by climate change, but the giant sequoias found there are especially vulnerable to temperature and precipitation changes, and they are expected to fare poorly as climate change continues into the future (Dorminey, 2013; Gonzalez, 2016). For this reason, the Mariposa Grove is an important site for climate change interpretation and education, which is featured significantly in the programs given there. The closure of the Grove may have reduced the overall climate change interpretation offered in the park, potentially impacting visitors' level of awareness of climate change in Yosemite. It is, of course, impossible to know with certainty how these unusual circumstances may have influenced visitors' and employees' responses during interviews. Long-term study of climate change perceptions in Yosemite is necessary to account for the always-changing social and natural conditions of the park.

Finally, this study is limited by low levels of attendance by visitors at ranger-led programs, low rates of interaction between visitors and employees, and limited readership

of park-produced texts. All the interpreters I interviewed said they talk about climate change with visitors at least on a weekly basis, and most claimed to discuss it daily. Yet of the 40 visitors I interviewed, only one couple had heard about climate change from a park employee; indeed, none of the other participants had attended a ranger-led program. Similarly, only one couple out of these 40 visitors reported seeing anything about climate change in the texts physically located in the park, and none had seen any climate change information online, despite having visited the website in advance of their trips. These findings are an important indication that Yosemite's climate change messages are poorly disseminated, but they cannot speak to the effectiveness of the content among audience members who are exposed to them.

In addition to the further research needed to address the limitations of this study, there are a number of other directions for future research that would provide further insights on climate change communication in public lands settings. First, audience reception studies would shed valuable light on the effectiveness of park-produced texts and employee-led interpretive programs. I have identified several ways in which Yosemite's signs and written texts fall short of their persuasive potential, but research into their precise effects on readers would be useful. Additionally, most of the interpreters I interviewed expressed the belief that their personal anecdotes of experienced climate change effects were more effective in persuading visitors of the reality and severity of climate change than purely scientific arguments. Reception studies of interpretive programs are necessary to substantiate these claims.

Second, more research is needed on climate change communication in other public lands sites. Many national parks, not just Yosemite, are severely threatened by climate change (Gonzalez, 2011). The diverse ecosystems of parks and other public lands mean

that climate change messages will vary, as will visitors' perceptions of climate change in those precise locations. The multitude of climate change engagement strategies and visitors' reception of those strategies all bear studying in order to understand how public lands, together, contribute to public climate change discourse.

Concluding a Conclusion

In Yosemite National Park, climate change is already perceptible to visitors and employees alike, and is a topic of discussion among both of these groups, along with park-produced texts. The arguments they make demonstrate that scientific arguments can come from diverse sources, and that evidence is not only based on technical knowledge, but also on local knowledge arising from sense of place. To many visitors and employees, Yosemite is, in the words of one participant, "God's country." This sense of connection to the park setting is an important catalyst for climate change engagement. With greater attention to the persuasive potential of precautionary and apocalyptic rhetorics in public lands contexts, and improved dissemination of climate change messages, Yosemite National Park stands to be not only one of the most visited national parks in the country, but also one of the most important sites of climate change education and inspiration for sustainability. The very future of the park may depend on it.

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